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Cruisers Kasuga and Nisshin^{*}

By Colonel N. Soliani.

The cruisers Kasuga and Nisshin are the last of a series of sister ships—ten in number—constructed during a period of about eleven years, from 1893 to 1904. They had a prototype in the earlier Italian cruisers Carlo Alberto and Vittor Pisani, which, except that the armament was less powerful, were of practically the same design. As a main armament, the Carlo Alberto and Vittor Pisani had twelve 6-in. guns, while the Garibaldi—the first of the list of the Kasuga and Nisshin type—had two 10-in. guns and ten 6-in. guns. But, as a compensation, the former ships had a long forecastle, which made them more suitable to ocean steaming and long commission on distant stations.

The fact of a ship design being repeated over and over again during a long period adds perhaps to the interest it may deserve; and this may also be enhanced by the circumstance that seven out of ten ships of the list passed, before being complete, to nations other than those for which they were intended and built, including the Kasuga and Nisshin, which, commenced and practically completed for the Argentine government, have taken an active and useful part in the present war in the Far East under the flag of the Japanese navy.

The cruisers Kasuga and Nisshin were contracted for to be exactly the same as the Giuseppe Garibaldi built and delivered to the Italian government, with the exception that the boilers were to be of the ordinary cylindrical type.

The armored citadel, while enclosing the bases of the two turrets, afforded complete protection to the armament of 6-in. guns on the battery deck. It is well to note that the boxing

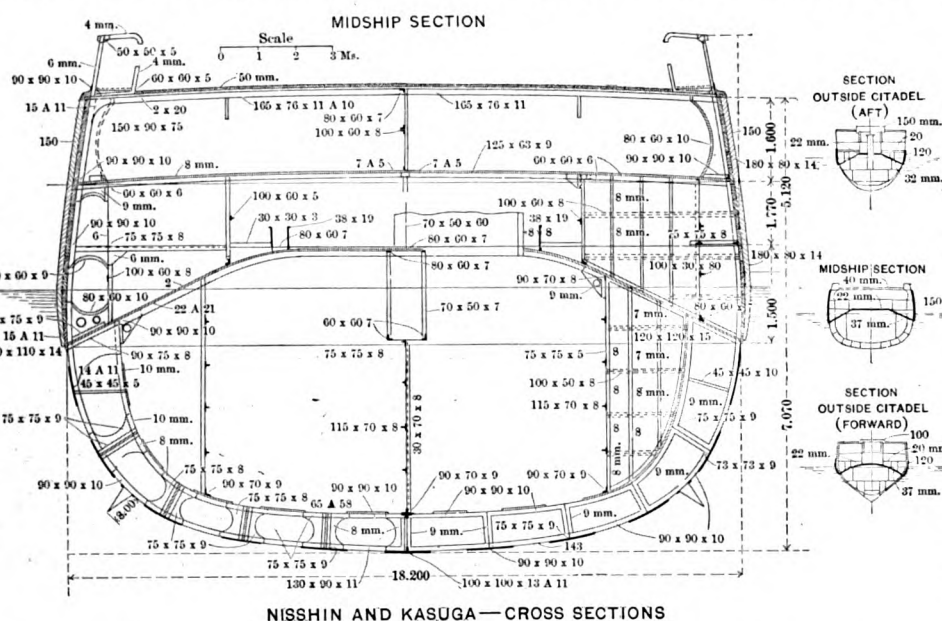
^{*}Paper read at the spring meetings of the Institution of Naval Architects, April, 1905.

of the guns inside the battery, although not carried out in such a thorough and efficient way as on the Japanese armor-clad Mikasa, was even then initiated, and its advantages understood, as the whole battery was subdivided into four compartments by means of a transverse bulkhead and a central longitudinal bulkhead

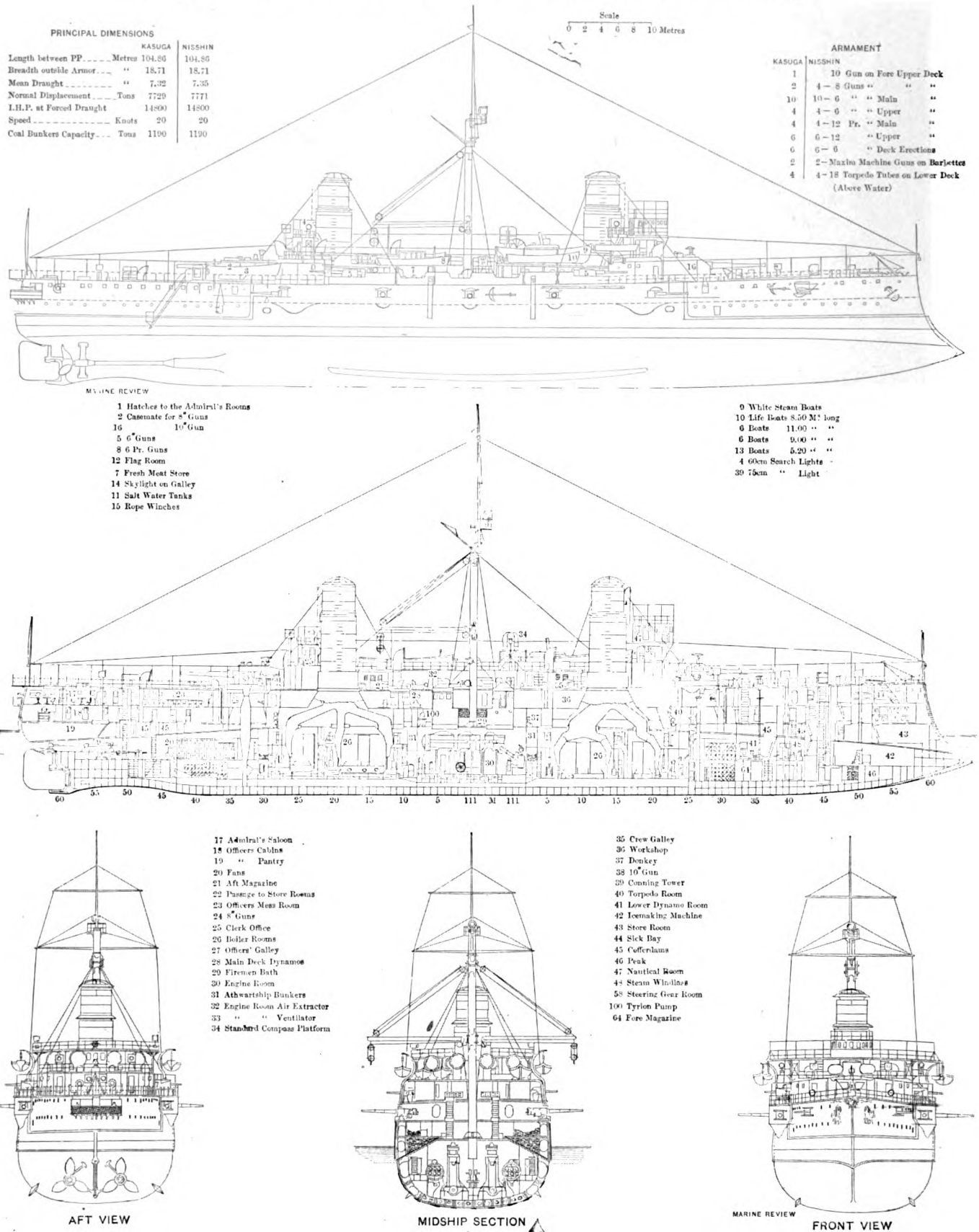
built up in connection with the funnel casings, to localize damage should a shell explode inside the battery. The side armor, not being very heavy, was, for simplicity of construction, not recessed with its lower edge on a shelf, but was simply attached with its backing to the flush side of the ship. The side armor and its backing therefore projected outside the plating, thus increasing the

width of the ship at the water line. A strong angle iron underneath the lower edge of the armor united it with the ship's side and gave it some support. The stepping out of the armor is a convenient point of support for shoring when docking.

The placing of the propelling engines in the middle, while not free from inconvenience, as it entails a greater length and weight of shafting and a higher position of the after boilers, which are necessarily fitted above the shaft tunnels, has some important advantages. First, it affords a real duplication of the steaming power, one group of boilers being entirely separated from the other group, with no connection whatever, so that any damage affecting one of them, whether in the boilers or in the steam and feed pipes, cannot in any way affect the other group. Greater facility of supervision and direction is obtained by the engineer in charge over the whole machinery, as without leaving the engine rooms he can keep personally in



Japanese Cruisers Nisshim and Kasuga



touch with and attend to either of the groups of boilers, as may be necessary. A shorter length of all pipings in connection with the engine room, and a more symmetrical and easy arrangement of the same, also result from this plan. And last, but not least, the central position of the engines is beneficial in reducing vibration in the ship due to the longitudinal couple

of the inertia forces of the moving parts, which need not be so well balanced. In fact, especially on the Kasuga and Nisshin, vibrations were scarcely felt at any speed, while quite appreciable vibrations were set up by the single cylinder dynamos forward when running alone, the ship being in harbor.

Attention may be called to a central tunnel running along the

middle line of the ship, close underneath the armor deck and between and above boilers and engines. The idea of such a tunnel was taken from English warships built or building at the time, and which had a similar central passage. But while in the British ships the side bulkheads of the tunnel went right down to the inner bottom and formed magazines below, in the Italian ships, failing the necessary space below, they were contented with the tunnel above, which, as in English ships, was intended as a thoroughfare for easy communication between the various machinery compartments, for easy and accessible passage of electric wires, speaking tubes, telegraphs, for the manœuvring of the main drainage valves, etc., and for eventual conveyance of ammunition from end to end, should necessity occur. This last utilization was, however, subsequently discarded, the tunnel being shut at the ends, with no communication with the ammunition compartments. The tunnel was supported in the engine rooms by the central longitudinal bulkhead which separates the two engines, and by pillars in the boiler rooms, in two rows along the central longitudinal passage between the boilers. In addition to the usual cofferdams around the hatchways of the protective deck, a cofferdam about 30 in. wide was built at the side of the ship from the protective deck up to main deck to allow leakages to be stopped at the sides, and the slopes of the armor deck to be cleared of water, should damage occur to the armor belt.

The specified speed of 20 knots was realized in nearly all the ships, including the Kasuga and Nisshin. This was a good speed fourteen years ago for such armored ships. The coal endurance also, as reckoned by the 1,000 tons of coal—increased in the Garibaldi and Kasuga and Nisshin to 1,100 tons—the ships could carry, was fairly good and quite ample for ships intended for Mediterranean service.

The Kasuga and Nisshin were contracted for on Dec. 23, 1901, to be built in twelve months; but before one of them, the Kasuga, was launched—under the name of Rivadavia—the time of delivery, for reasons not depending upon the ship builders, was protracted. However, I confidently think that the ships could have been completed near the original contract time, all the necessary materials like guns and armor, which affect so much the despatch of ship building, having been supplied in good time by the makers. In this respect the ship builders were much assisted by the Italian government, who helped them in many ways. The keel of the Rivadavia—now Kasuga—was laid on March 10, 1902, and the ship was launched on Oct. 22. The keel of the Moreno—now Nisshin—was laid on March 20, and the ship was launched on Feb. 9, 1903. Before the end of 1902 all the machinery for both ships was completed and ready to go on board. The cylindrical boilers being heavier, in order to simplify matters with regard to speed, it was agreed in the contract that the specified speed of 20 knots of the Giuseppe Garibaldi was to be obtained under precisely the same conditions of draught as in the trials of the latter. The conditions of air pressure in the stokeholds were, of course, modified to suit the different types of boilers; $\frac{1}{2}$ in. of air pressure was allowed for natural draught and not over 1.6 in. for forced draught trials.

GENERAL DIMENSIONS AND DATA.

Length over all	111.730 metres
Length at water line	108.800 "
Length between perpendiculars	104.800 "
Molded breadth	18.200 "
Breadth outside armor	18.710 "
Molded depth	12.190 "
Draught on trials—	
Forward	6.600 "
Mean	7.100 "
Aft	7.600 "
Displacement on trial	7,400 met. tons
Indicated H. P.	14,800 met. H.P.
Speed	20 knots
Total coal capacity	1,100 met tons
Rudder area	16.98 sq. metres

The armor plates were supplied by the steel works of Terni.

The structure and scantlings are shown on the drawing of the midship section. The hull is built of mild Siemens-Martin steel, no special steel being used anywhere. Wood was limited to upper deck planking, which is of teak, and to cabins and saloon furniture. No lining was fitted in the magazines. Shelves in magazines and shell rooms were all metallic. The armament was to be exactly like that of the Italian cruiser Giuseppe Garibaldi. Subsequently, however, in the Nisshin the forward turret with one 10-in. gun was, for convenience of time, replaced by a turret having two 8-in. guns, the same as aft. The military tops of the Giuseppe Garibaldi were suppressed, and two machine guns were transferred to upper structures; the armament of the two ships is, therefore, as follows:

10-in. guns	1	—
8-in. guns	2	4
6-in. guns on main deck	10	10
6-in. guns on upper deck	4	4
3-in. guns on superstructure	6	6
3-in. guns at ends main deck	4	4
1.8-in. guns on superstructure	2	6
Machine guns	2	2
Torpedo tubes (above water at sides) ..	4	4

The ammunition was supplied by the Ordnance Works of St. Chamond, in France. The turret guns have, as usual, a direct supply of ammunition from the ammunition rooms below by means of a hoist independent of the revolving turret structure. The 6-in. ammunition is raised from the magazines to the main deck by means of two continuous single chain hoists, one at each end of the main deck battery, whence the ammunition is carried on beam rails to the 6-in. guns of the battery and to the hand scuttles of the 6-in. upper deck guns. Minor ammunition is raised from magazines to the main deck and from the main deck to the upper deck by hoists of the alternate type. The working of turrets and hoists is by electric motors and gear built by the Stabilimento Elettrotecnico di Savigliano, Piemonte, who also designed and made the chain hoists mentioned above. During the steam trials at sea the gun trials were also made with good results as regards the guns, turrets, and the ship structure. The guns and turrets were tried in precisely the same way as was done by the Italian navy for the Giuseppe Garibaldi.

Propelling Machinery.—I shall not dwell much upon the propelling machinery, descriptions of which have been given by many technical papers—see *The Engineer*, Nov. 4, 1904. The following particulars will, I think, be sufficient.

The propelling machinery consists of two twin sets of vertical triple-expansion three-cylinder engines, located side by side in the central part of the ship, in two adjacent independent compartments separated by a central longitudinal bulkhead. Steam is supplied by eight cylindrical boilers in two groups of four boilers each, one abaft and one forward of the engine room. Each group of boilers consists of two double-ended and two single-ended boilers in two separate compartments, the double-enders being in the large compartment near the engine room. Each group has one funnel. The steam trials were carried out along the Eastern Riviera, near Rapallo, on the official measured base—6.035 metres long—from Punta Chiappe to Portofino, in a depth of about 300 ft. of water.

Both ships went on the official trials at sea after one mooring trial and one preliminary trial at sea, and with clean bottom just out of dock. The contract conditions of trials were simply a repetition of those set out by the Royal Italian navy for the Giuseppe Garibaldi, and the same results were to be obtained. The trial conditions of the Giuseppe Garibaldi did not contemplate speed—the ship's design being from the Italian naval construction department—but only development of steam power, and were as follows: One natural draught trial of six hours' duration in which the engines were to develop a mean power of 8,600 indicated horse power; one forced draught trial of one and a half hours' duration, in which the mean power developed was to be not less than 13,500 indicated horse power. In the natural draught trial the coal consumption per indicated horse power was not to exceed 0.900 kilos., about 2 lbs.

During the natural draught trials of the Giuseppe Garibaldi the air pressure in the stokeholds was nil, the Niclausse water tube type of boilers, with ample grate surface and small resistance to passage of gases, requiring no assisted draught. In the case of the Japanese cruisers, to compensate for the smaller grate area, and for the greater resistance to the passage of combustion gases through the tubes and flues, an air pressure of half an inch was admitted for the natural draught trials, as is customary in the British navy for cylindrical boilers. According to contract, the air pressure in stokeholds during forced draught trials was not to exceed 40 millimeters of water.

The results of the steam trials of both ships Kasuga and Nisshin are collected in the annexed table:

STEAM TRIALS OF CRUISER KASUGA.

Date of trial.....	July 22, 1903	Sept. 20, 1903
Duration of trial.....	6 hours	1½ hours
Draught—		
Forward	6.61m.	6.75m.
Aft	7.47m.	7.45m.
Mean	7.07m.	7.10m.
Displacement in metrical tons..	7,300	7,400
Sea	Calm	Calm
Wind	Light	Light
Mean air pressure in boiler-room	6	20
Mean steam pressure in boiler	165	165
Mean vacuum in condensers...	27½ in.	26 in.
Revolutions	93	106
I. H. P.—		
Starboard	5,210	7,450
Port	4,064	7,494
Total	10,174	14,944
Speed in knots	18.40	20.05

STEAM TRIALS OF CRUISER NISSHIN.

Date of trial	Oct. 26, 1903	Nov. 6, 1903
Duration of trial	6 hours	1½ hours
Draught—		
Forward	6.63m.	6.76m.
Aft	7.48m.	7.47m.
Mean	7.06m.	7.11m.
Displacement in metrical tons..	7,347	7,413
Sea	Calm	Calm
Wind	Light	Light
Mean air pressure in boiler-room	9.5	35
Main steam pressure in boiler.	165	165
Mean vacuum in condensers...	28.2 in.	28 in.
Revolutions	94.3	106.5
I. H. P.		
Starboard	5,340	7,439
Port	5,348	7,457
Total	10,688	14,896
Speed in knots	18.74	20.15

Broadly speaking, the power developed by the engines in both ships compares well with that developed by the Giuseppe Garibaldi's engines. The speed appears better in the Japanese cruisers, owing partly to the higher efficiency of the screw propellers, partly to the ships' bottom being perfectly clean, which was not the case with the Garibaldi, and finally to the speed observations on the Kasuga and Nisshin trials having been more accurate.

Electric plant.—The electric power station, which in the Giuseppe Garibaldi consisted of four continuous current dynamos, having a total power of 120 kilowatts, has been increased by 25 per cent by the addition of one similar dynamo. The five dynamos were placed, three in the dynamo-room below the armor deck and two on main deck inside the armored citadel. These two dynamos were intended for general use, and also as a reserve for the main station. The dynamos of the continuous current, four-pole, shunt type, were made by the Ansaldo firm, and worked at 110 volts and 300 amperes. The steam engines, of the compound tandem type, were supplied by Messrs. F. Tosi & Co., of Legnano. The power plant in addition to supplying current for the electric lighting of the ship, consisting of nearly 500 lamps and five searchlights—four of 24 in. and one of 30 in.—also

supplies current to many electric motors, viz., main artillery motors, ammunition elevators, ventilating fans, ash elevators, refrigerating machine, workshop, etc. All the wires, the principal of which are solid bars, are enclosed in metallic water-tight casings, or protected by Bergman's tubes. The searchlights were supplied by the Officina Galileo, of Firenze. Many useful electrical devices were also fitted on board, such as loud-speaking telephones, as an addition to the speaking tubes, and various electric tell-tales and indicators—like Molinari's revolution indicator, and a very ingenious general order transmitter invented by the chief engineer of the Argentine Commission, Captain Barbara.

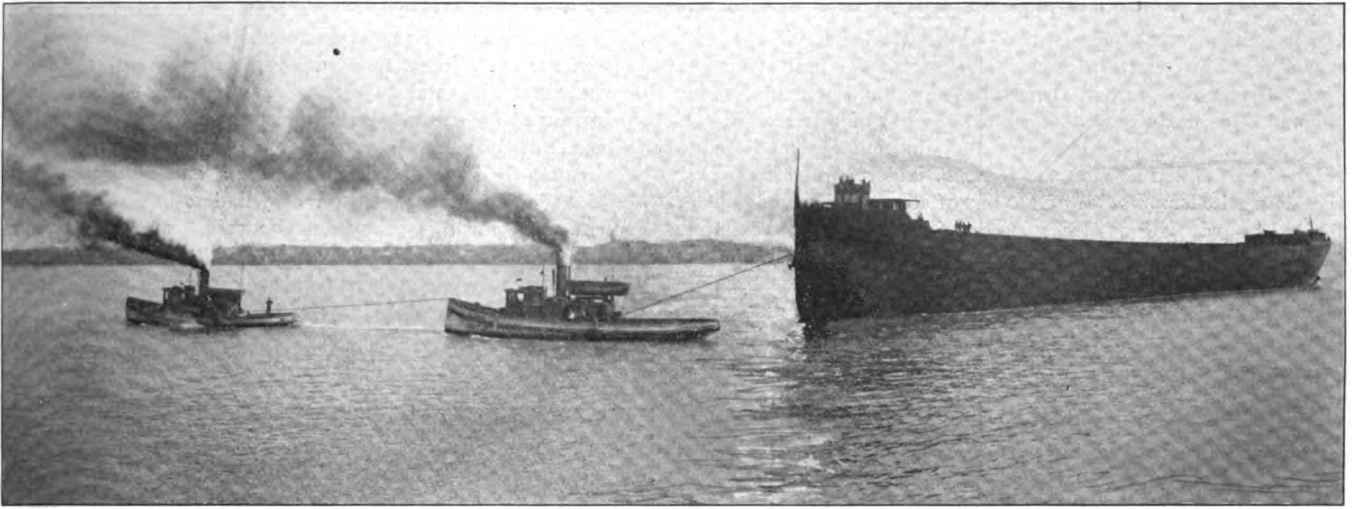
Water-tight doors.—The water-tight doors for communication between the machinery compartments are all high up in the central tunnel, and are of the sluice type, with rack and pinion. No other communication is needed. However, for convenience in ordinary service, two more water-tight doors were fitted below in the main bulkheads separating the single from the double-ended boiler compartments, and in way of the central passage between boilers. These two doors are of the hinged rack-and-pinion type invented by Major Quarleri, naval architect in the Royal Italian navy, which, by the single working of the pinion shaft, are not only swung round, but locked and unlocked also. All other important doors in the hold are of the slide rack and pinion type. On the decks above all doors are hinged.

Ventilation.—The general ventilation of the ship is secured by numerous electric fans, and is on the vertical independent system, each compartment having an inlet and exhaust of its own, so that there is no need of impairing the efficiency of water-tight bulk-heads by ventilating pipes passing through them. Moreover, inlet and exhaust having straighter leads, the efficiency of ventilation is better secured. The system is extended to the ventilation of magazines, the temperature of which was accurately tested after the end of the forced draught trials with very satisfactory results.

About 1899 steamers of the Pacific Steam Navigation Co. ran between San Francisco and Valparaiso, but when the Pacific Mail Steamship Co. got control of the business of the Panama railroad, the Pacific Steam Navigation Co. was forced to retire. Since the acquisition of the Panama railroad by the United States, the Pacific Steam Navigation Co. has decided to resume its service to Valparaiso. The vessels will go as far north as Victoria, B. C., and Puget Sound. The steamers of the Pacific Steam Navigation Co. are large, staunch and well equipped for passenger traffic in the tropics. They sail under the British flag and have been operated along the coast of South America, with Valparaiso as a home port.

The statement is made on what is regarded as reliable authority that the Pacific Coast Steamship Co. will soon award a contract for the construction of two new steamers to be used on the route connecting San Francisco with Victoria, B. C. and various Puget Sound ports. These new steamers are to each be 400 ft. in length with the guaranteed speed of at least 16 knots per hour, and will be able to make the run from San Francisco to Vancouver in about 47 hours—or six or eight hours better time than is now made. The record for the best run is held by the steamship City of Pueblo which has made the run between Victoria and San Francisco in 48 hours. The two prospective steamers are estimated to cost about \$1,600,000 and are to be completed within a year from the date of awarding the contracts.

The last of the six barge canal construction contracts was awarded by Supt. N. M. V. Franchot of the department of public works to F. A. Maselli & Co. of Pittsburg, Pa., the lowest bidders at \$1,005,982.50. The contract covers the section of North Greece west of Rochester.



THE LYMAN C. SMITH BEING TOWED TO THE SHEAR LEGS.

Launch of the

Lyman C. Smith

The hull of the new coarse freighter Lyman C. Smith was launched at the Wyandotte yards of the Detroit Ship Building Co., promptly at noon Saturday, May 27, and took to the water as nicely as the most exacting critic could expect. There was no great celebration to commemorate the event; there was no occasion for a celebration. The launching of big freight carriers on the great lakes is getting to be ordinary and except to those who have never seen a 10,000-ton boat take her initial dip the performance has come to be looked upon as routine business and handled accordingly. The event at Wyandotte was successful in every particular. The 4,000 tons of steel, which it has taken over four months to shape into the hull of a magnificent ship, glided into the slip with a tremendous splash, rolled once or twice and then righted itself and was immediately taken in tow by tugs and taken to the shear legs of the ship building company at Detroit where the engine and boilers will be installed and Supt. Chas. B. Calder has promised to have her ready to turn over to the owners, ready to go into commission in exactly four weeks from the time she was launched.

The Lyman C. Smith is building for the Lyman C. Smith Transportation Co., of Syracuse, N. Y., the capital in the new boat and that of the United States Transportation Co., the "type-writer fleet," being almost identical. The boat measures 545 ft. long over all, 525 ft. keel, 56 ft. beam and 31 ft. deep, and will be equipped with triple-expansion engine and Scotch boilers.

Miss Flora Bernice Smith, daughter of the Syracuse man for whom the boat was named, christened the new ship as



MISS FLORENCE BERNICE SMITH.

it left the ways.

The launching party, which traveled from Syracuse to Detroit in a special Pullman car, included Mr. and Mrs. Lyman C. Smith, W. L. Smith, Wilbert Smith, Mr. and Mrs. H. S. Wilkinson, Mr. and Mrs. D. N. Green, Geo. C. Ryan, H. C. Hemmingway, W. H. Stansfield, A. E. Nettleton, Paul Livermore, and John Cress, all of Syracuse, and S. W. Nettleton, of Toledo. President James C. Wallace, General Manager Robert Logan and Supt. Chas. B. Calder, represented the ship building company. Capt. Ralph J. Lyons will command the Smith.

MOST TRAVELED GRAIN RECORD

Duluth, May 31.—From Duluth to Chicago, then to Buffalo, then to Chicago, then to Minneapolis and then to Duluth—

perhaps, is the travel of a cargo of wheat that left the first named city late in April to help in breaking the Gates corner on wheat that was then on in Chicago. Arrived there the corner was busted, through the selling of banker Bigelow. The wheat was sold by its owners to the Armours who didn't want it at Chicago, and moved it to Buffalo where an attempt was made to sell it to millers and thus end it. But this was unsuccessful, for the millers did not care to buy at the price the Armour company thought it worth and it was

shipped back. Then the owners had been selling a little May wheat to Minneapolis millers at a very high price, because the millers seemed to want it, and this grain was put on trains and driven through to Minneapolis, at express speed to get it there before the close of the month. And there it is, to go now, no one knows where. It is probably the most traveled grain on record.



THE LAUNCHING PARTY ON THE STAND.

ENGINES OF THE ROOSEVELT

In the Engineer's number for May the Marine Review described the Peary arctic ship Roosevelt from the hull standpoint. It is now, through the courtesy of the Portland Co., Portland, Me., enabled to describe the engines of this remarkable vessel completely. The propelling machinery has been designed to develop about 1,000 I. H. P. under normal conditions with a boiler pressure of 140 lbs. of steam and the engine making 100 revolutions per minute, with a speed of vessel of about 10 knots per hour when she is at her load water line. For the purpose for which the vessel is intended, it has been deemed advisable to adhere to a moderate number of revolu-

The propelling engine is of the compound condensing type, with cylinders 24 and 52 in. diameter with a stroke of 30 in. It is of the open frame type with three forged steel columns on the front side and two cast iron housings on the back side arranged for single bar guides for the crossheads. All the valves are of the piston type, one for the high pressure cylinder and two for the low, all these valves are arranged in the space between the cylinders, the center of cylinders being spaced far enough apart for this purpose. The valves are operated by Stephenson links of the double bar type. The engine is fitted with steam reversing gear and balanced throttle valve, to be worked from below.

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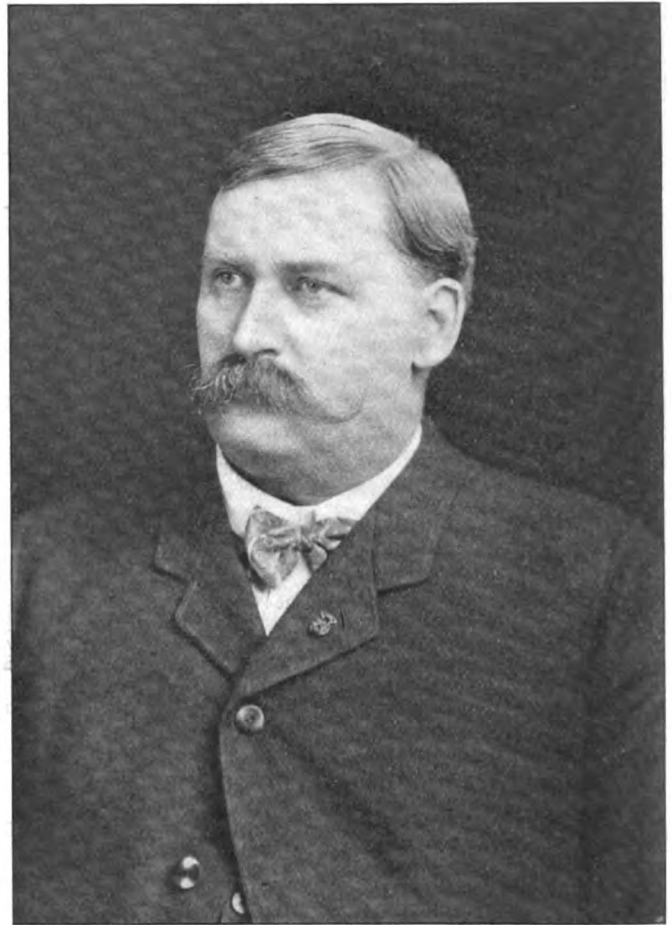


MR. FRANK A. JONES.
President Marine Engineers' Beneficial Association.

tions of the engine and design the engine strong and heavy in all its parts better to resist the severe shocks to which it will be subjected in forcing its way through the ice floes, rather than a lighter and quicker running engine. The shafting, propeller and stern bearing have been designed with a consideration of the severe thumping they will receive when the ship is working its way through the ice and are exceedingly heavy for the dimensions of the engine.

A reserve of power has been provided for in the design of the machinery by providing for an increased boiler pressure, the boiler, engine and auxiliaries are all designed for 180 lbs. steam pressure. This pressure will only be resorted to when the vessel is forcing its way through, or pushing large ice floes before it, and as the revolution of main engine will be less due to decreased speed of ship, the increased boiler pressure is expected to keep the I. H. P. up to or exceed the normal.

The following is a general description of the propelling machinery:



MR. GEORGE A. GRUBB.
Secretary Marine Engineers' Beneficial Association.

The pistons are of steel castings, single plate and conical in form and fitted with two packing rings. The piston rods are of forged steel $5\frac{3}{4}$ in. in diameter. The low pressure piston is fitted with tail rod. The crossheads are of forged steel with two gudgeons $5\frac{1}{2}$ in. diameter and $6\frac{1}{2}$ in. long.

The crosshead shoes are steel castings fitted with bronze gibbs 13 in. wide by 20 in. long on ahead surface. The slides are of cast iron and cored out for water circulation.

The connecting rods are 72 in. long on centers and are of mild steel forgings, the upper end is forked and fitted with solid bronze boxes, the lower end fitted with cast steel boxes lined with babbitt metal. The crank shaft is of mild steel forged in one piece, the crank pins at right angles to each other, the low pressure crank leading when working in head gear; the crank pins are 12 in. in diameter and 12 in. long, the four main journals are 12 in. in diameter and 14 in. long.

The bed plate is arranged for four main bearings. The bottom half of main bearings is semi-cylindrical in shape, and of

tough composition lined with babbitt metal, the top half is of steel, cast with the binder and lined with babbitt metal.

The main valves work in hard cast iron liners fitted in the steam chests. The valve travel for all valves is 7 in. and arranged for a cut off in high pressure cylinder of .65 and in low pressure of .70 of the stroke.

The high pressure piston valve is 12½ in. diameter with a port area of 42 sq. in. The two low pressure piston valves are each 14 in. in diameter with a port area of 124 sq. in.

The valve stems are of mild steel 2 in. in diameter at the stuffing box. They are guided at each end, the low pressure stems have balance cylinders fitted at the upper end to counter-balance weight of valves, links, etc.; the lower ends of the low-pressure stems are secured to a cast steel yoke guided in jaws secured to lower stem chest bonnets.

The reversing engine has a cylinder 7 in. diameter by 14 in. stroke, secured to high-pressure cylinder housing. The engine is fitted with a worm gear for hand turning, also indicator gear and lubricating arrangement for all the principal bearings.

The thrust shaft is of mild steel 11½ in. diameter with thrust collars 17 in. diameter; there are seven for ahead motion and three for astern motion.

The thrust block consists of two hollow cast iron shells made in halves and divided horizontally one for ahead and one for astern motion; the shells have recesses cast in for the thrust collars and the faces are lined with babbitt metal; both shells are mounted on one sole plate and each is arranged for independent adjustment; the shells are fitted with water circulation and the thrust collars run in a bath of oil.

The propeller shaft is of mild steel 12¼ in. in diameter. The propeller is of the sectional type and right hand hub and blades of cast steel; it is 10 ft. 6 in. in diameter and 12 ft. 6 in. pitch with a projected area of all four blades of 56 sq. ft.

The propeller is fitted with four blades but it is intended to use two only when the vessel encounters the ice.

The shaft log is lined with lead ¼ in. thick and is fitted with inboard stuffing box of cast iron lined with composition. The stern bearing is of steel casting and made very heavy. It is lined with staves of lignum-vitæ and the bearing is 40 in. long.

The surface condenser is circular in form and is independent of the engine framing. It is mounted directly over the air pump, the latter forming foundation for one end of condenser. The shell is of steel plate 7-16 in. thick, with water bonnets of cast iron, the shell is 48 in. in diameter and 8 ft. long, there are 1,200 ¾-in. condensing tubes set in composition tube sheets with brass screw glands. The condenser contains 1,800 sq. ft. of cooling surface.

The pumping outfit consists of one 8-in. centrifugal circulating pump, one horizontal simplex vacuum pump, one horizontal duplex main feed pump, and one horizontal duplex auxiliary pump. The circular pump is of the Morris Machine Co.'s manufacture. It is their standard pattern and is directly connected to a 7-in. x 7-in. engine. The suction of the pump is connected to the Kingston valve with an 8-in. copper pipe; it also has a 5-in. branch to the bilge fitted with a non-return valve. The discharge to condenser and from condenser overboard is through an 8-in. copper pipe. The vacuum pump and two feed pumps are furnished by the well known Warren Steam Pump Co. of Warren, Mass.

The vacuum pump has a steam cylinder 10 in. in diameter, a vacuum cylinder of 18 in. diameter and a stroke of 18 in. It is located directly below the condenser, the water end forming a support for one end of the condenser. The air pump suction is connected to the condenser with a 5-in. copper pipe and discharges to filter tank through a 4-in. copper pipe.

The main feed pump has steam cylinder 8 in. in diameter with water cylinders 5 in. in diameter and a stroke of 12 in. The suction of this pump is connected to the filter box and

fresh water tanks only, and discharge to the main feed pipe only.

The auxiliary feed pump is of the same dimensions as the main feed pump. The suction is connected to the fresh water tank, filter tank, 6-in. Kingston valve and bilge, with a discharge to the auxiliary feed pipe line, also to main deck through 2-in. hose hydrant valves, and a discharge overboard; there is also a 5-in. discharge pipe to the condenser to be used if the circulator becomes disabled.

Steam will be supplied by one single-ended three-furnace Scotch boiler and two Almy water tube boilers. The Scotch boiler is designed for a pressure of 185 lbs. and the safety valves of the water tube boilers are loaded to this pressure. It is intended that the vessel will steam under 140 lbs. working pressure under normal conditions, but when the vessel is working its way through the ice a reserve of power has been provided for by increased boiler pressure.

The Scotch boiler is 12 ft. mean diameter and 11 ft. 8 in. long outside of heads and contains three 38-ft. Morison suspension furnaces 9 ft. long and 217 3-in. tubes 9 ft. long, 153 of these tubes are of ordinary thickness (No. 12) and 28 are of No. 10 gauge, the remainder, 30, are stay tubes tapped into the tube sheets at each end and fitted with lock nuts. The stay tubes are arranged in the bounding rows and the extra gauge tubes are arranged in every other row horizontally and vertically.

There are two class E Almy water tube boilers 79 15-32 in. wide, 82 5-10 in. long and 113 7/8 in. high from bottom of ash pan to top of hood.

The heating surface and grate are as follows: One Scotch boiler 1,772 sq. ft. of heating surface; two water tube boilers, 2,572 sq. ft. of heating surface; total, 4,344 sq. ft. of heating surface. One Scotch boiler, 54 sq. ft. of grate area; two water tube boilers, 60 sq. ft. of grate area; total, 114 sq. ft. of grate area.

The boilers are arranged in a watertight compartment, the Scotch boiler forward and the two water tube boilers aft, the latter arranged side by side and connecting into one smoke box.

There is one smoke stack for all three boilers. It is made oval in plan 7 ft. in a fore and aft direction and 3 ft. athwartship. It is located directly over the water tube boiler with a flue connecting with uptake on Scotch boilers.

The main steam pipes and branches are all of copper and the auxiliary steam pipe is of copper but the branches are of extra thick wrought iron pipe with steel fittings. The boilers and steam pipes are covered with non-conducting material applied by the C. W. Trainer Manufacturing Co., Boston, Mass.

The boilers, engine, steam piping and all the auxiliaries are designed strong enough in all parts for the maximum steam pressure of 180 lbs. and they comply in all respects with the rules and regulations of the supervising inspector of steam vessels of the United States.

The coal bunkers extend the length of the boiler space in the vessel, each side of the boiler and fire room having a capacity of about 120 tons.

The fresh water tanks are located in the after part of the vessel. They are built to fit in between the "tween" deck beams, and they fit the shape of the vessel when located. They have a capacity of about 2,400 gallons. In connection with the fresh water tanks there will be a large open tank on deck fitted with steam pipes for the purpose of melting fresh water ice.

The minimum of space has been allotted to the machinery, as it is necessary to use all the space obtainable for coal and other supplies. Every cubic foot in the machinery space has been utilized with machinery, lockers, etc., with just enough clearance to get at the different parts. The weight of the entire machinery ready for sea, excluding coal and water in tank, is about 137 tons.



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Never before in the history of the lakes have the ship yards been blessed with such a prodigality of orders; never before have all available berths been practically taken a year ahead. There are sixteen ships under order for 1906 delivery. This is in striking contrast with the condition of a year ago when the ship building berths were practically vacant and no orders in sight. Indeed the summer of 1904 was well advanced before the ship yards received a single order; but after that they came fast. But such a condition as now confronts the great lakes ship builders is a new experience altogether. What with the orders for new ships, the lengthening of old ones and the inevitable repairs to the existing fleet, the ship builders of the great lakes can look forward to eighteen months of exceedingly active work. In the tables accompanying this article there is much food for reflection. One table shows that since the beginning of the present year the great lakes ship builders are working upon or have under order forty ships for the ore trade. Three package freighters and one car ferry are purposely omitted from this table in order that the comparative figures of average capacity of the ore carriers might be preserved. It will be seen

that these forty ships have a carrying capacity of 360,500 tons or an average of a trifle over 9,000 tons each. Ten years ago the average carrying capacity of vessels under construction was only 3,000 tons.

There is another feature in this table to be con-

NEW VESSELS FOR THE ORE CARRYING FLEET.

Yard	Name	Carrying Capacity Gross Tons	For Whom Building
Lorain	Ball Bros	8,000	G. A. Tomlinson, Duluth
Lorain	J. C. Wallace	10,000	Acme Steamship Co., Duluth
Lorain	S. M. Clement	8,000	Capt. John Mitchell, Cleve'd
Lorain	Phillip Minch	8,000	Henry Steinbruner, Cleve'd
Wyandotte	Amasa Stone	10,000	Pickands Mather & Co. Cleve'd
Wyandotte	L. C. Smith	10,000	U. S. Trans. Co., Syracuse
Cleveland	F. L. Robbins	6,000	W. H. Becker, Cleveland
West Bay City	Sylvania	9,000	G. A. Tomlinson, Duluth
West Bay City	Socapa	9,000	G. A. Tomlinson, Duluth
Lorain	W. A. Rogers	10,000	Niagara Tran. Co. Tonawanda
Cleveland	L. C. Hanna	9,000	Mahoning S. S. Co., Cleve'd
Wyandotte	P. Stackhouse	9,000	Mahoning S. S. Co., Cleve'd
Cleveland	W. A. Paine	8,000	C. L. Hutchinson, Cleveland
Chicago	E. H. Gary	10,000	Pittsburg S. S. Co., Cleve'd
Chicago	W. E. Carey	10,000	Pittsburg S. S. Co., Cleve'd
West Superior	G. W. Perkins	10,000	Pittsburg S. S. Co., Cleve'd
West Bay City	H. C. Frick	10,000	Pittsburg S. S. Co., Cleve'd
Ecorse	J. E. Davidson	9,000	G. A. Tomlinson, Duluth
Ecorse	Hoover & Mason	9,000	G. A. Tomlinson, Duluth
Ecorse	W. G. Mather	10,000	Cleve'd Cliffs Iron Co., Cleve'd
Ecorse	Peter White	9,000	Presque Isle Trans. Co., Cleve'd
St. Clair	G. H. Russel	7,500	Gilchrist Trans. Co., Cleve'd
St. Clair	F. J. Hecker	7,500	Gilchrist Trans. Co., Cleve'd
Toledo	James P. Walsh	8,000	C. O. Jenkins, Cleveland
Lorain	Unnamed	9,000	C. L. Hutchinson, Cleveland
Cleveland	Unnamed	6,500	Capt. John Mitchell, Cleve'd
Cleveland	Unnamed	9,000	Wilson Trans. Co., Cleveland
Lorain	Unnamed	10,000	Capt. C. L. Hutch'son, Cleve.
Lorain	Unnamed	10,000	Capt. John Mitchell, Cleve'd
Lorain	Unnamed	10,000	Capt. John Mitchell, Cleve'd
Bay City	Unnamed	9,500	Gilchrist Trans. Co., Cleve'd
Bay City	Unnamed	9,500	Gilchrist Trans. Co., Cleve'd
Wyandotte	Unnamed	8,000	Hugh McMillan, Detroit
Wyandotte	Unnamed	9,000	E. D. Carter, Erie
Cleveland	Unnamed	8,000	W. C. Richardson, Cleveland
Ecorse	Unnamed	10,000	Jones & Laughlin Co., Pitts.
Ecorse	Unnamed	10,000	Jones & Laughlin Co., Pitts.
Ecorse	Unnamed	10,000	Globe Steamship Co., Duluth
Ecorse	Unnamed	10,000	W. P. Snyder & Co., Pitts.
Toledo	Unnamed	8,000	L. S. Sullivan, Toledo
Total in one trip		360,500	
Total in season of twenty trips		7,210,000	

sidered. These forty ships for delivery during this year and next, carrying 360,500 tons on a single trip will in an average season of twenty trips move 7,210,000 gross tons of ore. That is a conservative statement for the season's work because granting reasonable dispatch a steamer confined to the ore trade will easily make twenty trips. In reviewing the

LAKE LAUNCHES DURING SPRING OF 1905.

Date	Name	Yard	Cargo Capacity
March 11	James C. Wallace	Lorain	10,000
18	Phillip Minch	Lorain	8,000
18	Sylvania	Bay City	9,000
25	Jas. E. Davidson	Ecorse	9,000
25	Amasa Stone	Wyandotte	10,000
April 4	L. C. Hanna	Cleveland	9,000
8	E. H. Gary	Chicago	10,000
22	Geo. H. Russel	St. Clair	7,500
29	Hoover & Mason	Ecorse	9,000
May 16	J. P. Walsh	Toledo	8,000
20	S. M. Clement	Lorain	8,000
20	Socapa	Bay City	9,000
27	Lyman C. Smith	Wyandotte	10,000

ore commerce it will be found that it was not until 1884 that the shipments of iron ore exceeded 1,000,000 tons per annum. These forty ships could therefore carry in a single season seven times the movement of twenty years ago. They could carry in a single season the combined movement of all the years from 1855 to 1870, and their capacity is in excess of even so recent a year as 1893, when 6,065,716 tons were moved.

A ship has been pushed overboard on the great lakes every ten days during the past spring, as one of

the tables accompanying this article shows. The independent vessel owner as well as the ore owning

greater part of the tonnage under order is for interests that must be called independent, that is to say, vessel owners without furnace or steel-making connections. It is clear, however, that the iron business of this country must continue to grow, otherwise there will be a surplus of tonnage on the great lakes. It is, however, a saving clause that the uses of iron expand in a sort of geometrical progression to the increase in population. As civilization advances iron finds additional employment in the arts and so long as the Lake Superior iron deposits remain, vessels of the great lakes will have sound and satisfactory employment. But nevertheless the figures incorporated in this article are worthy of serious thought.

CHICAGO GRAIN REPORT

Chicago, May 30.—Grain freights unchanged from last report at 1 cent per bu. corn to Buffalo, Port Huron and Georgian bay, the last Montreal engagements (all water routing) ruling in neighborhood 33½ cents corn. Receipts are turning quite actively and during past few days corn arrivals averaging 700,000 bu. daily. Coupled with the latter is the expiration of market manipulations in May corn and, by reason thereof, it is expected cargo operations will shortly be regulated to a more satisfactory chartering level.

The total lake and rail weekly shipments are some 500,000 bu. under the week ago—aggregate of some 2,500,000 bu., wherein again the all rail lines entered prominently in the hauling. The entire distribution notes via all rail of wheat 175,000 bu. of corn 253,000 bu., and 693,000 bu. oats: via lake steamers to Buffalo and other American points some 13,000 bu. wheat, 250,000 bu. corn, and 665,000 bu. oats: And lake routing to Canada points 154,000 bu. corn and 275,000 bu. oats.

Following are the comparative figures of weekly shipments and grain stocks:

Lake and Rail Shipments—

	This week.	Last week.	Same week last year.
Wheat	188,050	515,207	205,880
Corn	661,149	1,420,429	1,813,038
Oats	1,623,797	1,082,389	900,053
Rye	17,348	8,506	24,002
Barley	32,423	65,976	45,470

2,522,767 3,092,501 2,989,343

Lake and Rail Shipments—

	Shipments since Jan. 1, 1905.	Same time last year.
Wheat	5,534,307	5,123,384
Corn	25,152,097	20,934,898
Oats	20,137,798	19,969,866
Rye	540,919	724,193
Barley	2,157,417	2,480,409

53,522,538 49,232,755

Private and Public Elevator Stocks—

	This week.	Last week.	Same week last year.
Wheat	2,640,000	2,992,000	3,638,000
Corn	3,689,000	2,837,000	4,177,000
Oats	2,852,000	3,770,000	2,142,000
Rye	127,000	130,000	465,000
Barley	20,714	20,714	334,000

9,328,714 9,749,714 10,756,000

Capt. Frank Viger who sailed lake steamers for many years died at his home at Marine City last week. He was eighty-four years old.

Vessels under Construction on the Great Lakes for 1906 Delivery

AMERICAN SHIP BUILDING CO.'S YARDS

To be built at	Type	Dimensions in ft.			Style of Construction	No. of Hatches	Spaced Centers, ft.	Dimensions of Engines	Boilers, dimensions in feet and inches	Draft	Steam Pressure, Pounds	Capacity Gross Tons	For whom building
		Over all	Keel	Beam									
Lorain	Freighter	524	504	54	30	30	12	27½, 38, 63-42	14 6 x 11 6	Ellis & Eaves	180	9,000	G. L. Hutchinson, Cleveland
Cleveland	Freighter	520	508	54	30	12	12	27½, 38, 63-42	13 9 x 11 6	Ellis & Eaves	170	8,000	Martinetto & Bossmert Dock & Nav. Co.
Cleveland	Freighter	524	504	54	30	12	12	27½, 38, 63-42	14 6 x 11 6	Ellis & Eaves	180	9,000	W. C. Richardson, Cleveland
Lorain	Freighter	545	525	55	31	16	12	27½, 38, 63-42	14 6 x 11 6	Ellis & Eaves	180	10,000	W. C. Richardson, Cleveland
Lorain	Freighter	545	525	55	31	16	12	27½, 38, 63-42	14 6 x 11 6	Ellis & Eaves	180	10,000	W. C. Richardson, Cleveland
Lorain	Freighter	545	525	55	31	16	12	27½, 38, 63-42	14 6 x 11 6	Ellis & Eaves	180	10,000	W. C. Richardson, Cleveland
Bay City	Freighter	534	514	54	31	16	12	27½, 38, 63-42	13 9 x 11 6	Ellis & Eaves	180	9,000	Cape John Mitchell, Cleveland
Bay City	Freighter	534	514	54	31	16	12	27½, 38, 63-42	13 9 x 11 6	Ellis & Eaves	180	9,000	Cape John Mitchell, Cleveland
Wyandotte	Freighter	524	504	52	30	14	12	27½, 38, 63-42	13 9 x 11 6	Ellis & Eaves	180	8,000	W. C. Richardson, Cleveland
Wyandotte	Freighter	524	504	52	30	14	12	27½, 38, 63-42	13 9 x 11 6	Ellis & Eaves	180	8,000	W. C. Richardson, Cleveland
Cleveland	Freighter	524	504	52	30	14	12	27½, 38, 63-42	13 9 x 11 6	Ellis & Eaves	180	8,000	W. C. Richardson, Cleveland
Ecorse	Freighter	530	530	56	31	33	12	24½, 39, 67-42	(two) 15 6 x 12	Induced	175	10,000	Jones & Laughlin Co., Pittsburg
Ecorse	Freighter	530	530	56	31	33	12	24½, 39, 67-42	(two) 15 6 x 12	Induced	175	10,000	Jones & Laughlin Co., Pittsburg
Ecorse	Freighter	530	530	56	31	33	12	24½, 39, 67-42	(two) 15 6 x 12	Induced	175	10,000	Jones & Laughlin Co., Pittsburg
Ecorse	Freighter	530	530	56	31	33	12	24½, 39, 67-42	(two) 15 6 x 12	Induced	175	10,000	Jones & Laughlin Co., Pittsburg
Toledo	Freighter	565	485	56	31	24	12	24½, 39, 67-42	(two) 15 6 x 12	Induced	175	10,000	W. P. Snyder & Co., Pittsburg
Toledo	Freighter	565	485	56	31	24	12	24½, 39, 67-42	(two) 15 6 x 12	Induced	175	10,000	W. P. Snyder & Co., Pittsburg
Toledo	Freighter	565	485	56	31	24	12	24½, 39, 67-42	(two) 15 6 x 12	Induced	175	10,000	W. P. Snyder & Co., Pittsburg
Toledo	Freighter	565	485	56	31	24	12	24½, 39, 67-42	(two) 15 6 x 12	Induced	175	10,000	W. P. Snyder & Co., Pittsburg

GREAT LAKES ENGINEERING WORKS, DETROIT

GRAIG SHIP BUILDING CO., TOLEDO

steel companies have faith in the continued expansion of the iron business of the United States for the

BRITISH NAVAL ARCHITECTS IN CONFERENCE

The spring meetings of the British Institution of Naval Architects have just been held, and the papers read thereat are of especial interest and value to students of marine architecture. Professor J. H. Biles contributed a paper on "The Strength of Ships, with special reference to experiments and calculations made upon H.M.S. Wolf." He said that the committee on torpedo-boat destroyers, appointed by the admiralty, made investigations in connection with the strength of these vessels, which led to a review, on the part of the members, of the theory of the relation of stress and strain, and a determination of the amount of stress that came upon a ship at sea. It is generally admitted that the maximum stresses were those which were due to the longitudinal bending of the ship, and that the relation of stress and strain under a given bending moment was based upon a generally accepted theory. The ordinary longitudinal strength calculations afforded a means of comparing the strengths of the various types in certain assumed conditions. A ship experienced the most severe stresses when she was pitching and heaving among large waves, but in ordinary strength calculations the question of pitching and heaving was not considered, and only the statical effect of the change of distribution of buoyancy due to the wave formation was determined. The results of the deduced stresses obtained during the experiments were very reliable for a large number of positions. In the hogging series the experiment for each position was only conducted once, but in the sagging series the experiments were repeated several times with the indicators in the same positions, so that it was possible to compare the curves obtained during different experiments under exactly the same conditions. In the latter case during different experiments made under the same conditions of bending the dial readings and consequent deduced stresses were for the most of the positions practically the same. This demonstrated that whenever the instruments were fixed in these positions, and the vessel is subjected to the same bending moment, the same dial readings were recorded. The condition of lading of the boat during experiments was that of fully-equipped sea conditions. The draught of water ranged from 7 ft. 3 in. to 7 ft. even keel. From observations of the indicators under different conditions of weather and steaming it would appear that when the ship was rolling even to such an extent as to submerge the gunwale and a portion of the deck, the stresses set up were very small, the needles in the indicators being scarcely disturbed. In the case of pitching and rolling combined, such as the vessel crossing the seas in an oblique direction, the stresses set up were very much less than those through pitching only, the needles in the instruments moving at the greatest from two to three dial divisions each way, equivalent to a stress of 0.95 tons to 1.45 tons, even in a rough sea. The greatest observed effects on the indicators were when the vessel was steaming at fastest speed with head on to wind and sea, her bow lifting and riding on one sea, and then diving in the next advancing one, this latter striking her to such an extent as to cause quite a perceptible tremor to pass through her; the main portion of the hull being then in the trough of the sea, and the vessel being subjected to sagging stresses. Whilst steaming slowly through the sea the period of time in passing from maximum tension to maximum compression varied from 10 to 14 seconds. Whilst steaming at fastest, head to wind and sea, it was rather difficult to observe, but from best observations it appeared to be about from 6 to 8 seconds. The greatest recorded stresses were due to sagging, and were as follows: Keel, 5.38 tension; deck, port, 2.88 compression; deck, starboard, 2.14 compression. When the vessel was in a regular series of waves of standard size the passage of the waves along the length of the vessel caused a variation in the stresses, due to the position of the crest of the wave. From calculations made it had

been determined that the maximum theoretical stresses which came upon the Wolf in the vicinity of the after boiler-room when on a standard wave, were: Keel, 7.14; deck, port, 5.30; deck, starboard, 5.30. Hence the stresses actually experienced after prolonged seeking for high seas were much less than those obtained under standard conditions. The vessel successfully stood in dock stresses much higher than those found at sea.

Admiral Fitzgerald testified to the industry and resource and zeal with which Prof. Biles carried out the experiments. It had been decided by the admiralty that the report of the committee was not to be published, but it was very much like the shell of the egg—Prof. Biles's paper gave them the meat out of the egg.

Sir William White, late chief constructor to the British admiralty, said it was most important, in considering the comparison made between the stresses calculated on the ordinary assumptions with the stresses ascertained actually by measurement, to remember they were dealing with an extremely simple structure. He was delighted to find that there was so close an agreement between the ordinary standard of calculation and the observed results. But the method was tested in the simplest form—a single deck ship. If one had a complicated structure like a ship with many decks, it would vary very much from that simple case. It was fortunate that comparison had been made in that way, because the result was most valuable, and had a direct bearing upon future practice. All who had had to do with strength calculations had been convinced that the standard ordinarily used must give results above the stresses which occurred in practice, otherwise many ships which went about the world in a perfectly satisfactory manner could not continue to hold together.

Dr. Bruhn, surveyor to Lloyd's Register, in a paper on "Some Experiments on Structural Arrangements in Ships," said that experiments had been undertaken by the committee of Lloyd's register with a view to obtaining reliable information concerning various methods of construction or forms of girders which had from time to time been proposed to be adopted in ships, and had been submitted to the committee of Lloyd's Register for their approval. Some of the information gained by the experiments was previously established by calculation, and where that was the case the results of the one method only confirmed those of the other. In some instances, however, the experimental information obtained could not readily have been derived from purely abstract investigations. The experiments were planned by the late Mr. T. C. Reed, some years ago, and were carried out under the supervision of the surveyors to Lloyd's Register at Newcastle-on-Tyne. The aim of the series was to determine the relative stiffness of the various forms of framing, viz., plain angles, angles with reversed frames, deep frame girders, channel bars, bulb angles, and zed bars. The series was divided into two parallel subdivisions: one where only the frame girder itself was tested, and another where a plate 12 in. in width was riveted to the frames to represent the outside plating of a ship. All the sample girders were 9 ft. in length, and were resting freely on blocks 1 ft. from each end, leaving an unsupported span of 7 ft. The specimens were subjected to bending by weights placed on a scale pan at the center of the span. The deflections, both vertically and horizontally, were recorded in a length of 7 ft. for each increment of load, and any other movement in the structure was carefully noted. The material for all the girders was tested in the ordinary way, in accordance with the requirements of the rules of Lloyd's Register. The tensile strength and the percentage of elongation in a length of 8 in. were recorded for each specimen. The chief facts obtained from the series of experiments were the deflections of the various girders in a length of 7 ft. for a known concentrated load applied at the centers, while the girder was

free to deflect vertically and horizontally. As the frames of a ship were always prevented from bending sideways by the shell plating, it was necessary to eliminate the effect of such actions, where they occurred in the experiments, in order that the information obtained could be applied to the framing of a ship. A glance at the curves of deflection for the girders without plates riveted to them would show that a comparison of the resultant deflections of these girders when free to move laterally must be entirely different to a comparison, when lateral deflection is prevented. For instance, the resultant deflections of the zed bars without plates were, for the same load, $2\frac{1}{2}$ to $3\frac{1}{2}$ times as large as those of the channel bars of the same scantlings. This comparison of the relative stiffness of the two types of girders was correct for the conditions under which the experiments were carried out; but it afforded no direct criterion of the stiffness of these forms when lateral deflection was prevented, as was evidenced by the results of the experiments on the girders with plates riveted to them. These plates practically prevented side bending, in addition to their otherwise making the experimental conditions more like those of the actual framing of a ship. The tendency for certain girders to deflect sideways for a vertical load arose from the unsymmetrical form of their cross sections with regard to a vertical line through their center of gravity. The channel section was in this respect symmetrical, and the zed form unsymmetrical. Hence the very large difference between the resultant deflections of these girders when no plates were riveted to them. In order to eliminate the effect of side bending, where such was found, and thus to obtain a fair comparison for symmetrical and unsymmetrical sections alike, as they were used in practice, it was necessary to employ the formulæ for oblique bending. There would always be some points of difference between the specimens tested and the parts in the ship they were supposed to represent. There would, therefore, always be some difficulties in the way of an absolutely direct application of the results of the experiments. In bridging these hindrances, and making the results applicable to actual ships, resort must be had to more or less abstract methods. It was desirable that the arrangements, both in the general design and in the details of the sample structures, as well as the general experimental conditions, should as nearly as possible correspond to those of the counterparts and to the circumstances in the actual ship, with a view to obtaining more reliable information and minimizing, as far as practicable, the difficulties in the way of a direct application of the results obtained. In designing the sample structures it was also important to see that the point under consideration was brought out, and other questions eliminated as far as possible. The experimental girders ought, therefore, in such cases to be comparatively short and deep. In general, it was not possible simply to construct a portion of a vessel and then test it. If that were done some information would be gained with regard to the part where the structure yielded, but the chances were that it would not have any bearing on the point it was desired to investigate.

Prof. Biles during the discussion that followed the reading of this paper said their thanks were due to the author and to the committee of Lloyd's Register for their experiments to clear up debatable points in the structure of ships. He hoped they would give further results not only with breaking strengths but with the elastic deformation throughout the whole of the experiments.

MARGINS AND FACTORS OF SAFETY.

Mr. A. E. Seaton contributed a paper on "Margins and Factors of Safety and their Influence on Marine Designs," which was read by Mr. R. W. Dana. He said that every structure and machine must be so designed that when properly constructed it was capable of safely carrying the load or developing the power for which it was intended for a consider-

able period. At the same time such structures and machines were, as a rule, for good and sufficient reasons, not made stronger or heavier than necessary. In recent years a demand had arisen for something that should be as light as possible consistent with the necessary strength; in such cases, however, endurance was not generally of prime consequence. Notwithstanding that, every designer liked to have a margin on which to "come and go," as well as one which should not be trenched on under normal conditions. But one had only to read an ordinary specification of a ship or engine to perceive how nebulous appeared to be the knowledge of their authors of the dangers for which factors and margins of safety were supposed to be the insurance. It might be urged that a constant danger for which provision must be made was faulty workmanship, both in the treatment of the material in making and in the construction of the structure. This was to a considerable extent true in the days of scrap iron forgings, and plates made with a hammer, often barely equal to the work. Today, with ingot steel forged in a press and rolled to homogeneity, and manipulated with drilling machines of every sort, the danger was minimized, so that small provision, if any, was sufficient to meet any danger from these causes, especially for boilers which had been made under the inspection of independent surveyors. This consideration should influence the officials of the Board of Trade and other authorities in determining the factor of safety they demand for boilers made, under inspection, of the best materials and the best workmanship. Formerly boilers were built with or without definite rules, in such a way as seemed best to each maker. It was then said by the authorities: "As we know nothing of your boilers more than we can see from outside, and we have no rules by which we can gauge by calculation your design, you must show us in some practical way that the boiler is safe for the working pressure you propose. Now, seeing that the safety valve, when blowing, generally does not prevent a rise of a few pounds pressure, and that if you want to load them to 10 lb., you must test to 20 lb., so that you have a margin of 10 lb.; then, if the steam rises from any cause from 25 lb. absolute to 35 lb., or 40 per cent, the boiler will be able to stand it." It would be admitted readily that, considering that most of these old boilers had flat surfaces all over, and the stays were often loosely jointed or riveted to attachments, a pressure test was absolutely necessary, and, further, the chances of breaking or bursting under test sufficiently great to prohibit doing so with steam. So long as the test was double that of the working pressure, a factor of safety of four was scarcely advisable, consequently they had today to make boilers with plates $1\frac{3}{4}$ in. thick, when $1\frac{1}{2}$ in. would do perfectly well, as it would be quite safe and satisfactory, for the factor of safety then would be 3.86. Now, assuming the elastic limit to be 55 per cent. of the ultimate, and if the working pressure were 200 lb. per square inch, then such a boiler would require to be pressed to 424 lb. before the elastic limit was reached; it might therefore with perfect safety be tested to 340 lb., which would satisfy the admiralty for a working pressure of 250 lb.; the German government for 265 lb. (as all it asked was 75 lb. above the working pressure for all boilers where working pressure exceeded 75 lb.), and any locomotive builder in the country 227 lb., for they would test no higher than 50 per cent above working pressure; while Lloyd's, the Board of Trade, and others, would permit only 170 lb. In order that a steamship might have a margin of safety to ensure her doing the intended voyage at the schedule speed, most shipowners insisted on having the trial trip speed considerably in excess of it; the builders accepted these conditions, and knowing they were legally liable for heavy penalties for non-performance of the speed, even when no penalty was named, usually designed the ship and provided engines and boilers for a still higher speed, so that they might have in their turn a margin of safety.

Hence it came to pass that a ship whose service speed was to be $17\frac{1}{2}$, not uncommonly did $19\frac{1}{2}$ knots on trial under service conditions, and that not on a series of runs on the measured mile, but on a long course often of 100 miles. The effect of this kind of margin was most serious, both on the design of the machinery and the ship. The latter must be formed with finer lines than there was really occasion for, with a corresponding loss of displacement; the machinery was much heavier and bulkier than necessary, thereby taking away from the carrying capacity and often also from passenger space as well. The engine cylinders had such clearances as to reduce the steam efficiency at the service speeds; and the screws necessary for the high trial speed were not of the best proportions for the service speeds. He thought that neither ship-owners nor builders always fully realized the evils and cost of this pernicious way of ensuring satisfactory performance. If the speed on service was to be $17\frac{1}{2}$ knots, why not design the ship for it? If it be urged that, to make up time lost by fogs or bad weather there must be a reserve of some kind, this could be done by increasing the power and obtaining the higher speed with a slight decrease in the efficiency. It was surely better to have the lower efficiency during these occasional times than during normal conditions. Take the case of an ordinary cargo boat, or "tramp" steamer, engaged in a fairly regular trade where 10 knots was the service speed. If, as was not uncommon, the owners asked for 11 knots on trial trip, the prime cost of this margin was £3,150, and the annual charge was £4,714, or 15.71 per cent on the cost; whereas a margin of even 20 per cent more power would entail an extra cost of only £1,540, and an annual charge of only 2.84 per cent on the capital, while the speed would then be 10.5 knots in smooth water. To get this speed with a finer form would require less indicated horse power, but a loss of earning power, so that the cost of the margin would be 7.4 per cent, a serious matter with this class of ship. In the case of a large cargo steamer carrying passengers at a scheduled speed of 14 knots the margin of a knot would entail an extra prime cost of £13,050, and an annual charge of nearly £26,000; whereas, by being content with a 20 per cent power margin, which would give a speed margin of seven-tenths of a knot, the annual cost would only be £9,576, or 6.38 per cent of the cost, and the prime cost £11,410; and nearly four-tenths of a knot by 10 per cent more power, at a cost of £6,370, and an annual charge of only 3.56 per cent. It was quite true that there must always be some margin, and that in some instances the cost of these high-speed margins might be justified, but in the majority of them this could hardly be so. His object was not so much to advocate a factor of safety of four for boilers and a power margin for ships as to draw the attention of ship owners as well as ship builders and engineers to these matters, that they might see what was really involved in getting the so-called margins of safety they so frequently demanded, and so be better able to decide whether the gain obtained thereby was commensurate with the extra cost. The boiler question was, of course, the most serious, as there seemed absolutely nothing to justify such an extravagant margin as was now imposed on ship owners to their loss and detriment.

Sir William White said no doubt the scientific design of structure of any kind was at its best when no more material was put in than was absolutely necessary when provision was made for working conditions of all sorts. In his professional life he had found the argument from experience rather troublesome to deal with. In ship designing new problems had very often to be faced, and it was reasonable that the designer should spend a little more money in the stage of construction rather than be penalized later on. The "factor of safety" assumed that they knew what was the largest demand likely to be made, and then a margin was allowed. The true scientific method was to know the requirement. He quite understood

Mr. Milton's point of view, but he thought the admiralty experience in the matter was worth consideration also. It was well known that the admiralty method provided a constant difference between working pressure and test pressure. After long experience of the working of that system he thought the mercantile practice might gain by it, just as admiralty practice had benefited in many ways from advances made in the mercantile marine.

AROUND THE GREAT LAKES

The annual meeting of the American Association of Freight Handlers will be held at Minneapolis June 13-16.

The Tennessee River Navigation Co., Chattanooga, Tenn., intends to build a new steamer for its service about 75 ft. long and 33 ft. beam.

It is understood that the engines of the battleship Louisiana will be installed by June 1 at the Newport News yard.

A parted wheel chain caused the steamer Thomas Davidson to strand. The vessel was released after lightering 300 tons of her cargo.

Canadian vessels last week fixed a minimum rate for grain from Chicago to Montreal at $3\frac{3}{4}$ cents per bu. This is far lower than the export rate via American ports.

The steamer Amasa Stone bound down on her first trip stranded half a mile from the light ship at the foot of Lake Huron. She had to be lightered somewhat before she could be released.

The war department has ordered the removal of the Cleveland terminal bridge over the bed of the Cuyahoga river and it must be replaced by a bascule structure before April 1, 1906.

C. Sorenson & Sons, Manistee, Mich., would like to know the whereabouts of Capt. Irons who was captain on the tug Wheeler about two years ago in Manistee.

C. H. Starke & Co. of Milwaukee have closed a contract with the Empire Ship Building Co. for the largest steel dipper dredge on the lakes. The craft will be 125 ft. long and 43 ft. beam.

George McGarey who was first mate of the steamer H. B. Hawgood from which Capt. Ellis lost his life has been appointed captain of the steamer.

During the thick weather on St. Clair river this week the Gilchrist barge Antrim was struck by the steamer Charles Hill, formerly the Anchor liner Delaware. Several stern plates in the barge will have to be removed.

The steamer Superior City of the Pittsburg Steamship Co.'s fleet bound from the head of Lake Superior to South Chicago struck between North Manitou and Pyramid Point and was badly damaged. She will be docked at South Chicago.

Notwithstanding the protest of the great lakes dredging interests the government suction dredge General Gillespie is to be brought to the lakes from Boston. One thing can be set down—if private contractors were permitted to do the work that the Gillespie will do it would be more cheaply done.

The fire tug Kittie D. of Dunkirk, N. Y., which was used last summer for illegal fishing in Canadian waters and released on bonds was returned to the Canadian authorities at Port Colbourne last week pending the decision of the privy council which will be handed down in July.

The new official watergauge of the Lake Carriers' Association is now in operation directly over the office of Smith's coal dock at Sandwich. In addition to depth of water at the Lime Kilns, signals showing whether the water is rising or falling are shown. A white ball in the day time and a white light at night indicate that the water is rising. A red ball by day and a red light by night indicate that the water is falling. Should neither the ball nor light be showing the water is stationary. Vessels can at present load to safely 18 ft. 5 in.

TRIAL TRIP OF THE MONTREAL

The palatial new steamer *Montreal*, of the Richelieu & Ontario Navigation Co., had her trial trip on Saturday, and proved even better than had been expected. On her way from Sorel, where she has been built over after the disastrous fire of March, 1903, she made the trip in two hours and 52 minutes, beating all records so far made on the river by about half an hour, at the least. Capt. Johnston, the marine superintendent of the company, was in charge of the expedition. The trial trip took place in the afternoon. The president of the company Mr. Rodolphe Forget, M.P., the general manager, Mr. C. F. Smith, Mr. F. Percy Smith, secretary, Mr. Thos. Henry, general passenger agent, Capt. Johnston, marine superintendent, Mr. Jos. F. Dolan, formerly of Toronto, and now passenger agent in Montreal, and several other officials of the company, including Mr. Foster Chaffee, the Toronto agent, did the honors of the new boat to the large gathering of guests foregathered on their invitation.

The steamer was constructed in the Bertram yards in Toronto, and brought down the rapids in the autumn of 1902. The most experienced pilots were employed to bring her down, as she was too long to come through the canals, and she was by long odds the largest craft to attempt shooting the rapids. She touched once or twice in the Lachine rapids, but the damage was speedily repaired, at Sorel, and the new ship was brought to Montreal at the close of the season in 1902, to be fitted up, and have the interior painted and decorated for the season's business.

One Saturday evening early in March, 1903, however, fire broke out in the portion of the ship where the painters had been at work, and a few hours later a bundle of twisted steel represented what had been a few hours before the pride of the Richelieu Company. The hull was towed to Sorel shortly after the opening of navigation in 1903, and the steamer has been entirely rebuilt, and is now the most imposing craft to be found in the inland waters of Canada. Her lines and fitting resemble, on general principles, those of the celebrated Fall River Line.

The guests spent a very pleasant afternoon inspecting the appointments of the vessel, all of which are on an elaborate scale. The refreshment room for the occasion was situated on the main deck forward, and thither the guests repaired after they had completed their tour of inspection.

On the return trip speeches were made, the orators mounting the grand staircase, whence they could be seen by those on the three decks. The Acting Mayor, Ald. Couture, made a short speech, and presented the ship with a set of flags on behalf of the city of Montreal.

Mr. Rodolphe Forget, president of the company, followed, and on behalf of the company thanked those who were present for having accepted the invitations sent them, and also the city for its kindness in remembering the company with a new set of flags. He spoke of the history of the R. & O. Company, and remarked that more should be done by the government for inland navigation.

Hon. Mr. Prefontaine was next called upon. His appearance was greeted with cheers which the orchestra interpreted as a sign that the oratory had concluded, and immediately played "God Save the King," much to the delight of the guests and to the amusement of the minister, who humorously expressed his thanks. He complimented the company upon the splendid addition to their fleet, stating that he had been all over the Dominion, and seen all that there was to see in the way of steamships, and unquestionably the *Montreal* was a credit to the whole Dominion. He took opportunity to reply to the remarks of Mr. Forget anent the Government, and related what had been done during the past eight years, comparing it with what had been done by the preceding government, much to the advantage of that now in power. The matter of marine

dry docks and the railways should have been settled in 1845, but it was not, nor was it settled yet. He then made the announcement that it was about to be settled, and that *Montreal* would have a dry-dock, and Sorel a marine railway. He added that a dry dock was needed in this district. He also wanted Montreal to become the national port of Canada, in such a way that the whole Dominion, without prejudice, would view it as such and be proud of it, as well as of the St. Lawrence route.

The Mayor of Sorel, Mr. C. O. Paradis, a director of the company, next spoke. As an evidence of the pleasure it gave the people of the city of Sorel to have this magnificent ship on the route, he presented the *Montreal*, on their behalf, with a handsome clock, which was set up against the main bulkhead.

Mr. C. J. Smith, general manager of the company, spoke of the work of the company, and was pleased that they had now got this magnificent vessel ready for the passenger traffic of the present season. He was also greatly delighted with the announcement of the Hon. Mr. Prefontaine, as the lack of a dry dock at this point and a marine railway at Sorel, had been weak spots in the route.

Hon. Robert Mackay, chairman of the Harbor Commissioners, made a few remarks, as did also Ald. Lavallee, and the boat reached the docks about six o'clock, all on board being greatly delighted with the appointments of the ship and her conduct en route.

The *Montreal's* dimensions are: Length, 340 ft.; width of hull, 44 ft.; width over guards, 75 ft. 6 in.; moulded depth, 15 ft. Her engines are of the triple-expansion variety, of 3,000 H. P. She has side-wheels fitted with feathering curved-steel buckets. Steam is supplied by six Scotch cylindrical boilers of 11 ft. diameter and 12 ft. long, with working pressure of 185 pounds. Her fire pumps, life-saving apparatus, etc., are of the most modern pattern. The electric light plant will furnish power for 1,200 sixteen candle-power lamps. Pumps supply running water to every state room. The entire steamer, including state rooms, is steam-heated.

The dining room is on the main deck aft, and will seat 150 passengers. Forward of the dining room is the entrance hall, with the purser's office and baggage room on one side and smoking room on the other. This entrance hall has rubber-tiled floor, and is paneled in dark mahogany, relieved by large panel pictures of the seasons, in bronze relief.

The arrangement of the upper saloons and state rooms, on the first and second upper decks, is much the same as on the company's steamer *Kingston*. The main stairway to the upper saloon is in the entrance hall, and in front of the landing space at the top of the stairway is the gallery deck, at the head of which is a large painting of "Cardinal Richelieu," by Suzor-Cote. In consequence of the great width of the steamer there are three rows of state rooms on each side of the central portion of the vessel. The total number of state rooms is 250, including twenty parlor rooms with bath rooms attached.

Maj. Dan C. Kingman, government engineer with headquarters at Cleveland will allow the Donnelly Contracting Co. of Buffalo to finish their incomplete contracts at Conneaut and will probably in addition give the company a contract to build the 250-ft. extension on the shore end of the new 750-ft. east breakwater.

The Erie & Buffalo Transportation Co. has elected the following officers: J. J. McLean, president; T. F. Noble, treasurer; C. R. Glick, secretary. Major R. J. Saltsman and Leo Schlaudecker with the officers comprise a board of directors. The steamer *Keystone* which belongs to the company will do a general passenger and freight business between Erie and Buffalo.

A SUCCESSFUL MOTOR CANOE

By A. W. Smith

Great interest has been aroused in the development of small motor craft, and while there are many classes of motor boats, so far as we know the motor canoe described here is the only successful one in operation. It is an ordinary stock paddling canoe 13 ft. long, 35 in. beam, 14 in. deep, built



GOING IN TO DOCK.

by the Canadian Canoe Co., Peterboro. There is built on from about the center of the keel to the stern a "skeg," through which the shaft runs to a point sufficiently low to keep the propeller submerged under all conditions.

This "skeg" not only answers the purpose mentioned, but also provides a good long bearing for the shaft, and stiffens the canoe considerably. It is fastened through by bolts sufficiently long to be riveted underneath to the 1 in. half-oval iron which serves as a protection to the keel, and is carried from the bow to the stern, at which point it projects as a shoe protecting the propeller blades from injury either while running or landing. The rudder is attached to this shoe, and steering can be controlled from any part of the canoe, as an



THE CANOE AT REST.

endless cord runs through screw eyes and pulleys attached to the gunwales.

Motive power is supplied by a two-cycle, single-cylinder 1-H. P. gasoline engine, set up exactly in the center of the canoe. It is fastened to a bed made from two 4 in. pieces of ash, laid longitudinally, with two cross pieces formed to fit the shape of the bottom of the canoe. These pieces also act as braces, and are fastened from the outside by brass screws.

The propeller shaft from the engine to the skeg is encased in brass tubing, and is supported by two bearings about 2 ft. apart. This stationary casing also acts as a bearing where it enters the skeg, and the shaft can always be kept lubricated, and notwithstanding the 9 ft. length of the shaft there has been no side play.

The gasoline tank, (capacity 3 gallons) is in the bow under the decking and a lead pipe conveys the gasoline to the carburetor. This worked all right in smooth water, but where rough water is the rule cylindrical tanks placed amidships are advised. Battery box, spark coil, and switch, together with the connecting wires are waterproof, and are within easy reach of the party running the engine. The discharge pipe from the water jacket is run through the muffler. A tool box is used as a seat by the party running the engine, and while one person can easily operate the canoe better speed can be obtained by carrying two persons. Four adults can sit comfortably in the canoe, and an average speed of a little over 10 miles per hour during the past season was obtained with the equipment described. The cost of the canoe equipped is about \$180, and when fully loaded the draught is less than 12 in.

It is impossible in a short description like this to give details but I am confident that this type is not only the ideal one for pleasure seekers, but that it will also appeal to prospectors, explorers and surveyors, who need something portable, safe, speedy, and strong enough to stand hard usage. As an illustration I might state that in August with fairly choppy water, on Lake Ontario we carried in the canoe four adults and two children and towed for several hours an 18 ft. row boat containing as many more people. I found the canoe very steady in the roughest weather, easily steered and quite dry.

A. E. Dunn, St. Enoch's Square, Toronto, did the necessary wood work, and the engine was designed by E. J. Philip, now of Brandon, Man., and the Dominion Motor & Machine Co., Toronto, installed the engine. Wm. Wilkinson, one of their employees successfully solved some intricate problems in connection with the gasoline supply, which on account of the limited head afforded by a craft so shallow proved difficult.

LAUNCH OF THE REPAIR SHIP ALPHA

There were two launchings at the Brooklyn Navy yard last week, one was the repair ship, a floating machine shop, which was christened Alpha by Miss Margaret Baxter, daughter of Naval Constructor W. J. Baxter who designed the ship. The other was the barge Transfer, built for the department of supplies and accounts, which was christened by Miss Edmonia Adams, the little daughter of Capt. J. P. Adams, Sr., member of the inspection board. The repair boat Alpha is recognized as the most completely equipped craft of her class in the world. She is the first of her type to be placed in the United States navy, and is intended to facilitate the repair work upon vessels sent to the yard. In cases of great urgency, she will be towed, having no motive power of her own, to Tompkinsville, for instance, to minister to the wants of ships lying there. She will only do this when the yard is too crowded to admit of bringing the ship there. The machine equipment of the Alpha is such that she will be able to do everything save make castings, but, once the castings are furnished her, she can produce the required fitting. She will be used mainly for minor repairs, and Mr. Baxter thinks that she will be able to reduce greatly the cost of repairs at the yard. She is as square as a box, so there is neither bow nor stern to her. At one end is a 10-ton crane, capable of lifting even a 6-in. gun, and when the crane is engaged in a task of that magnitude, there are tanks which may be filled with water, to keep her on an even keel. She is 115 ft. long, 40 ft. wide, 12 ft. deep and draws 6 ft. of water.

The Transfer is a fat, overgrown tug, 122 ft. long and 30 ft. wide, an out-of-proportion proportion, which fits her to handle heavy weights over her side. She is a single-screw boat, and will be used in placing stores aboard ships. Her cargo carrying capacity is said to be remarkable.

LIVERPOOL SHIPPING LETTER

Liverpool, May 22.—An important combination of Bristol Channel dock owners has been agreed upon at Cardiff, it having been decided to form a Dock Owners' Association for the Bristol Channel. The companies which have joined this organization are: The Cardiff Railway Co., The Bristol Docks, Commercial, Alexandra, Newport & South Wales Railway Co., The Taff Vale Railway Co., The Milford Docks Company, Post Talbot Railway & Docks Co., Sharpness New Docks, the Gloucester & Birmingham Navigation Co., and the Swansea Harbor Trust. Among the aims and objects of the association are the promotion or opposing of legislation or regulations affecting the common interests of the affiliated undertakings, and the obtaining of legal decisions upon disputed points of common interest. Mr. A. Beasley, the general manager of the Taff Vale railway, has been unanimously elected president. It was stated that the vessels which cleared during 1904 from the harbors and docks represented paid tonnage dues on 18,728,752 tons.

Considerable progress has already been made with the work of constructing the Cunard 25-knot steamers, although, of course, they will not be ready for over twelve months yet. The double bottoms of the two great liners have been laid down and some of the framework, and even plates, laid in position. Some new details of these vessels have just become known. It seems that originally it was the intention of the builders to make each vessel with three funnels, but, owing to the requirements of the admiralty regarding the engine and boiler space, it has been found necessary for each to have four funnels. In accordance with the admiralty demands and the fact that the vessels are to serve as armed cruisers, each ship is to carry on the main deck several 4.7 guns. The vessels will be 800 ft. in length, and will have a gross tonnage of about 30,000 tons. The turbine engines are to drive four screw propellers, and they will thus be the first vessels to be propelled by quadruple screws. The total indicated horsepower of the engines will be 70,000. The engine and boiler spaces are to be protected, in accordance with admiralty requirements, by six-foot bunkers on either side, and these sections will, when emptied of their coal, be filled with sea-water and serve in much the same way as armor plating. The steamers are to be fitted with long-distance wireless telegraph appliances, and will have a speed of 25 knots an hour.

Steamship companies sailing from Liverpool to America have appointed a committee of principals to look into the Aliens bill now before the British parliament, with the view of drafting certain amendments. As the bill stands, it is believed it might be applicable to second-class American passengers who might possibly under the bill be subjected to the same examination as third-class passengers from the continent of Europe. The desire of the shipping companies is to have the bill so amended as to make sure that the wrong class of people will not be included in it by mistake. Americans would certainly resent such an examination, and if it were carried out it might drive many such passengers to the lines sailing from continental ports. Since the inauguration of intermediate boats in the Liverpool lines, the numbers of second-class passengers, arriving and departing from the Mersey, appear to be increasing every year.

Naval strategists and technical experts in Britain are just now engaged in wordy warfare as to the displacement of the ideal warship of the future. It is urged that while the possession of large battleships costing upwards of one million sterling apiece may have an important moral effect upon possible enemies, it is really the number of vessels that constitute the most material factor in England's supremacy of the seas. The protection of her food supply and commerce to England is everything, and this, it is said, can be more effectually accomplished by many fast and powerfully-armed cruisers than by a lesser number of battleships of colossal power but less

speed. The Admiralty apparently do not yield to the clamor for smaller battleships, as the one which is shortly to be laid down at Portsmouth is to be the largest the world has ever seen. The newer battleships of the British navy are all having their furnaces fitted for the consumption of oil fuel. Although much money has been spent experimenting with this kind of steam generator, it is extremely unlikely that it will ever be absolutely relied upon. Not only because we have no home supply and that in the time of war it would be highly dangerous for one navy to be absolutely dependent upon the importation of fuel is this so, but because there are other serious objections to its use. In warfare the greatest of these is the risk of fire. The loaded coal bunkers at the side of a ship afford a very valuable protection against an enemy's guns, whereas if oil were stored, the explosion of a shell among the tanks would naturally cause a serious conflagration. When used as alternative fuel only the small quantities are stored in the double bottoms well below the water line, and, therefore, to a great extent out of danger. The use of liquid fuel is still only in the experimental stage, the progress of which has been greatly delayed by the accident to the destroyer *Spiteful*, which has been fitted purposely for testing the possibilities of oil as fuel. The future of the ram is another matter to which the Admiralty have of late been applying very serious attention, although the result of their deliberations is not likely to be known before the official details of the new battleship which is shortly to be commenced are issued. It has been stated in some quarters that the ram, which has hitherto been such a prominent and deadly weapon in a battleship, is to be discontinued on the ground that it will be a saving of weight, and will enable extra guns to be carried. Since torpedoes have been advanced to such a pitch of perfection, and having in view the armor penetrating power of our quick-firing guns it is highly improbable that in a naval encounter ships would ever get within ramming of one another, but that one or both must fall victims to the deadly fire at so close a range. So far as the saving of weight, however, is concerned, it is a matter of very minor importance. A ram weighs something like 14 tons, whereas a 6-inch gun, with carriage and mounting would be about 11 tons, besides which there would be the supports and casements, bringing the total up to about the same as the ram, so that at the outside only room could be made for one gun. Then it must also be remembered that if the ram is dispensed with, a very heavy stern piece, weighing half as much would have to be substituted. It is, therefore, considered very doubtful indeed whether the Admiralty would make so great a change for so small an advantage.

The seaworthiness of motor-boats has been put to a severe trial in the race from Algiers to Toulon, and it would seem that the little craft, speedy and convenient as they may be, are not at all fitted for voyages on the open sea. Indeed, it is not to be expected that they could successfully encounter rough winds and waters, and probably the promoters of the race did not anticipate that the Mediterranean would prove so unkind in mood in May as it has done. Every one of the boats engaged had to abandon the race during the second stage—indeed, most of them seem to have sunk, and grave fears were entertained for the safety of more than one crew when it was known that a storm had swept over the course. The fact is that the builders of the boats can have known but little of the strains of sea work, and although the little craft were amply equipped for lake and river jaunts, they were in no way fitted to withstand the perils of a storm at sea. While the pluck of the sailors of the boats is worthy of all commendation, there is really no lesson to be learnt from the affair, except the very obvious one that he who goes to sea must do so in a sea going boat, otherwise he courts the destruction which has overtaken the little motor-boat fleet.

The reply which Lord Inverclyde has made to Mr. Bruce

Ismay is the subject of much conversation in shipping circles here. On every point Lord Inverclyde challenges the president of the Atlantic Combine, and denies that the Cunard Company ever attempted to obtain admission into the International Mercantile Marine Co. It is feared that the correspondence which has revealed much that the public had not known before, far from quieting down the prevailing troubles will probably be found to add to its gravity. As the American mail contract seems to be the groundwork upon which the tentative agreement now null and void was based, it may be of interest to outline the arrangement with the United States government. Up to the autumn of 1903, the mails were practically on the Wednesday by the American line to Southampton, and on the Saturday by the Cunard line to Queenstown or Liverpool. The American line received a fixed subsidy of about \$640,000 per annum for their share of the work; the Cunard Company, the open Postal Union rate of 42 cents per pound for letters, and 4 cents per pound for newspapers. In November, 1903, the American line changed their sailing day from New York to Saturday instead of Wednesday. The consequence was that the White Star line sailing from New York on Wednesday, then picked up the mails for the first half of the week which the American line had previously carried, and the American line got the bulk of the mails for the second half of the week under their contract with the United States government. These mails were of course withdrawn from the Cunard line which suffered accordingly. In all the negotiations that have since taken place between the International Mercantile Marine Company and the Cunard Company, the question of the transfer of the sailings of the American line from New York on Saturday to some other day was made an essential condition, and it was anticipated that, in order to effect a settlement of rates and other matters in which they were vitally interested, the combine would be willing to relinquish a portion of the extra revenue they had received from the mails through the change of sailing day. The International Marine Company have requested the American postoffice to agree to an alteration of the sailing day of the American line from Saturday to Thursday or Friday. As, however, the American line receive \$15,000 a voyage for carrying the mails, quite irrespective of the quantity carried, they would still have been in receipt of this sum if their sailing day had been altered as suggested and an additional charge would then have been thrown upon the United States postoffice, who would be called upon to pay the Cunard line on whatever additional weight of mails they should carry from New York on the Saturday, in consequence of the American line's sailing being fixed for an earlier day. The sacrifice would in this event have been made not by the International Mercantile Marine Company, but by the United States postoffice. Whether for this or some other reason, the United States postoffice declined to assent to the proposed change.

The approximate receipts from the Manchester Ship Canal for April are \$185,540 against \$145,220 in April, 1904. The total revenue for the four months of the current year is \$634,850 compared with \$623,650 for the same period last year, an increase of \$11,200.

NEW FIRM OF COX & STEVENS

An announcement of interest to yachtsmen and to the engineering world in general is the dissolving of the firm of Gardner & Cox, and the formation of the new firm of Cox & Stevens who will carry on the same business as naval architects, engineers, yacht and vessel brokers in their new offices in the Morris building, Broad and Beaver street, New York. The members of the new firm are Irving Cox, E. A. Stevens, D. H. Cox and Edwin A. Stevens, Jr.

Col. E. A. Stevens of Castle Point, a member of the famous

engineering family, the Hoboken Stevens, brings to the new firm the reputation of being the foremost authority in this country on ferryboat design and construction; is a naval engineer, a naval architect, and, among other positions of trust, is at present consulting engineer for New York city during the construction of the new municipal ferryboats for service between New York and Staten Island.

Irving Cox, a partner since its formation of Gardner & Cox, is a naval architect and naval designer, of large practical experience, in connection with the construction and contracting for the various yachts and commercial vessels built during the firm's existence; coming to that firm with a previous thorough training in one of the leading shipyards as a practical constructor. Through his efforts the firm of Gardner & Cox was able to establish one of the largest and best conducted departments for the sale, charter and exchange of yachts in this country.

Daniel H. Cox resigned as assistant naval constructor of the United States navy to accept a responsible position with the firm of Gardner & Cox, and has for the past three years been one of the managers of its business. After graduating from the naval academy in 1894 with distinction, he was sent abroad by the government to the Royal Naval College, Greenwich, England, for a course in naval architecture and marine engineering. After his return from abroad, prior to his resignation he was engaged in designing and superintending the work of construction of naval vessels.

E. A. Stevens, Jr., the fourth member of the firm, is a graduate of the Stevens Institute, and he is well equipped to carry on his duties in the new firm, being also an amateur sailor and designer of considerable experience.

From the above it would appear that the new firm is admirably equipped to carry on a successful business and should have a bright future, both as regards yacht and commercial work.

SAULT STE. MARIE CANAL SEMI-CENTENNIAL

August 2 and 3 have been selected as the dates for the Semi-Centennial Celebration of the opening of the first canal at Sault Ste. Marie. Hon. Peter White has been elected president of the commission and Charles Moore of Detroit, secretary and treasurer. Mr. Charles T. Harvey, who superintended the construction of the first canal, will be the marshal of the celebration. With these officers the celebration will undoubtedly be a great success but the vessel interests should in every way lend their aid.

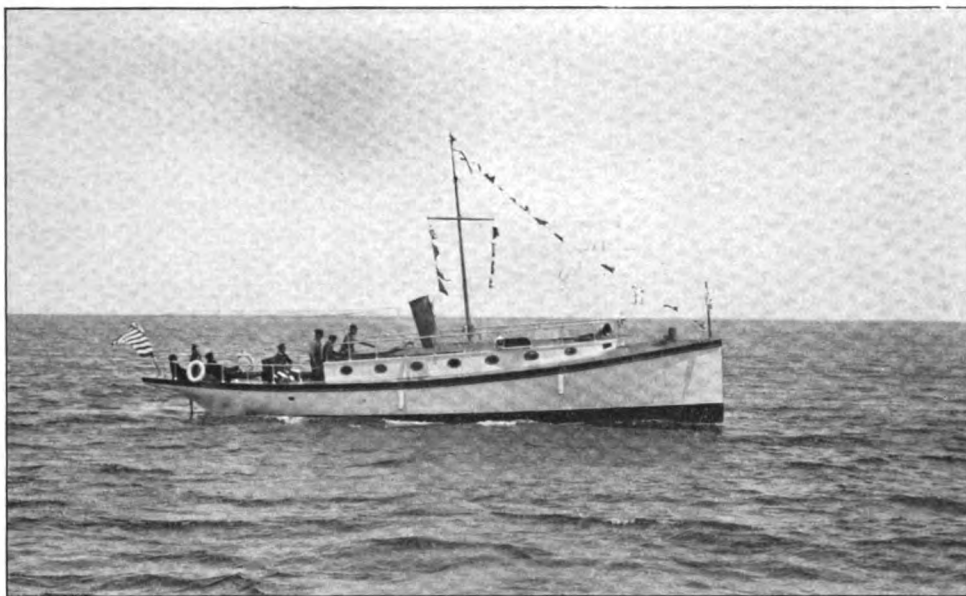
SIXTEEN STEAMERS UNDER ORDER FOR NEXT YEAR

The Great Lakes Engineering Works at Detroit has secured its fourth order for a 10,000 ton steamer for 1906 delivery. The order was placed by W. C. Snyder & Co. of Pittsburg and Harvey H. Brown of Cleveland and the steamer will be a duplicate of the two steamers ordered by Jones & Laughlin of Pittsburg. She will be 550 ft. over all, 530 ft. keel, 56 ft. beam and 31 ft. deep and will have triple-expansion engines and Scotch boiler. This makes the sixteenth steamer under order for next season, the American Ship Building Co. having eleven orders, the Great Lakes Engineering Works four and the Craig Ship Building Co. one.

Capt. Thomas Donnelly of Kingston, Ont. adjusted the claims in the damage done by the steamer Cuba at lock No. 2 of the Welland canal last week. A hole was knocked in the starboard of the vessel and her rudder and the blades of her wheel were also broken. Three gates of the lock were destroyed, several farms were washed out by the overflow and three-quarters of a mile on the Grand Trunk track was washed away.

GASOLINE BOAT VAYA

The Truscott Boat Manufacturing Co., St. Joseph, Mich., has just completed the gasoline boat Vaya for the Buffalo Yacht Club of Buffalo, N. Y. The launch is 54 ft. over all, 10½ ft. beam and is good depth and high freeboard, being designed for Lake Erie service. The cabin, which is nicely finished in Flemish oak, is on the trunk cabin order, giving ample head room inside. It is arranged with cushioned locker seats extending along both sides with ample toilet accommodations. The machinery equipment consists of a four-cylinder, four-cycle Truscott gasoline marine motor of 65 h. p., installed partly below the after cockpit floor and extending into the cabin. This arrangement is designed to place the control of both machinery and boat under one operator at either bridge or cabin. An awning covers the entire cockpit. Light spars and rigging are added for dress as well as a sham smoke stack, which also affords cabin ventilation. The Vaya made the trip from the Truscott works to Buffalo under her own power in charge of Mr. J. B. Williams, secretary and treasurer of the Buffalo Yacht Club, and manned by W. G. Bodamer, captain, and A. F. Hopkins, engineer.



GASOLINE BOAT VAYA.

GARY'S CARGO RECORD

All cargo records on the great lakes have again gone by the board. The new steamer E. H. Gary built by the Chicago Ship Building Co. for the Pittsburgh Steamship Co. loaded 12,003 gross or 13,443 net tons of ore from Escanaba to South Chicago. Of course on the short trip the Gary was favored with deeper water than can be obtained on the Lake Erie route. She drew 21 ft. 3 in. The nearest approach to this record was the trip of the Augustus B. Wolvin from Escanaba to South Chicago, carrying 10,973 gross tons or 12,285 net tons. In other words the Gary's cargo exceeded the Wolvin's by 1,030 tons. The Gary is 9 ft. longer than the Wolvin. The Wolvin's ore record last year on the Lake Superior-Lake Erie route was 10,245 gross tons with 11,474 net tons from Duluth to Erie. Her coal record was 10,569 tons of anthracite from Buffalo to Milwaukee. She did not carry grain last year, otherwise she would have broken that record also. It can be expected now, however, that the Pittsburgh Steamship Company's new quartet will surpass the Wolvin's record throughout the year should the stages of water be favorable.

FREIGHT SITUATION

The feature of the week in lake trade has been the attempt to break the coal rate five cents. The present rates, 35 cents to the head of the lakes and 45 cents to Milwaukee and Chicago, are the same as were paid last year and were the opening rates for the present year. The Pittsburgh Coal Co., however, has been endeavoring to slash this rate five cents, but the vessel owners are practically a unit against accept-

ing the cut. All the leading owners and agents of Cleveland held a meeting last week and decided to maintain the rate at the existing figure. The Pittsburgh Coal Co. says that it is doing some business at the reduced rate but it is not known what owners are carrying the coal. For this reason shipments of coal have been light and the heavy movement that was expected about the first of June has not materialized.

Ore is moving freely and vessels are getting excellent dispatch. The holiday caused by the observance of Memorial Day has not affected the ore trade as much as was expected,

shippers making extra efforts to care for the vessels as they arrive and frequently unloading them in a single day. Figures for the May movement of ore will not be known for a day or two, but they are known to be very heavy.

The grain and lumber trades continue light.

AT THE HEAD OF THE LAKES

Duluth, May 30.—Grain shipments from Duluth last week were nearly 1,500,000 bu. and receipts were small, less than 55,000 bu., so the decreases in stocks were important. There is little hope for larger receipts until new crop, and shipments should be such as will pretty well clean out the 10,000,000 bu. still left in store. The movement of flour and other package freight is very light now, and does not seem to improve as rapidly as was hoped for. There is a large copper shipment from the Keewenaw peninsula, but this is greater in value than in tonnage. Montana is sending some copper to the head of the lakes for shipment east but not so much as formerly. The receipts of western shingles are large and they make deckloads for many package liners. Wheat is all going out by the liners, at 1¾ cts. a bushel.

No date has yet been set for the launch of the U. S. Steel Corporation ship G. W. Perkins, under construction at the yards of the Superior Ship Building Co. It will be in the course of a few weeks, however. Of late work on the vessel has been going on quite fast. With Perkins out of the yard there will be very little going on there for some time.

Vessel masters approaching the new aerial bridge at Duluth are getting into the habit of blowing their drawbridge signals, which is recommended as a safeguard of value.

On account of Sunday work at the ore docks and the pressure of summer business, one of the pastors at the ore shipping port of Two Harbors has announced that his sermons during the season will be of but 15 minutes duration.

The Duluth & Iron Range railway has received several large locomotives from the Northern Pacific road, which it will use to help out during the summer. Eight of these engines are expected. Of the new steel cars, of which 400 are coming, the first are being put in service.

LORD INVERCLYDE'S REPLY

In last week's issue of the Review was published Mr. J. Bruce Ismay's letter to Lord Inverclyde in which Inverclyde was charged with conducting negotiations in 1902 for the disposal of a controlling interest in the Cunard Steamship Co. Lord Inverclyde has written the following letter to Mr. Ismay in reply.

CUNARD V. COMBINE.

LORD INVERCLYDE'S REPLY.

Cunard Steamship Company (Limited),
Liverpool, May 18, 1905.

Dear Mr. Ismay,—I must confess that I have difficulty in understanding the object with which your letter to me of the 9th of May was written. But as it is evident that you are laboring under the erroneous belief that those responsible for the control of the Cunard Company are actuated by hostile feelings towards the International Mercantile Marine Company, it is necessary that I should answer it.

You imply that the Cunard Company in 1902 endeavored to obtain admission, on its own terms, into the Atlantic Shipping Combination, and that owing to the company's efforts not being successful, a feeling of hostility has been created. The Cunard Company never attempted to obtain admission into the combination.

The facts in regard to the "lengthy negotiations" which you state were conducted by me in 1902 "for the disposal of a controlling interest in the Cunard Steamship Company to the syndicate then engaged in the formation of the International Mercantile Marine Company" are as follows:—

On March 3, 1902, stockbrokers in Glasgow acting for the trustees of the will of the late Lord Inverclyde were asked by another firm of Glasgow stockbrokers to ascertain what price would be taken for a large block of Cunard shares.

The principals on whose behalf the inquiry was made were neither named nor indicated in any way, but I mention the inquiry so that this statement as to the negotiations to which you have referred may include any negotiations which were or which might by any possibility have been on behalf of the International Mercantile Marine Company. The fact that the agreement under which the International Company was formed had been signed on Feb. 4, 1902, was not made public until May 8, 1902. At the time when the stockbrokers' inquiry was made I had no knowledge of the existence of any such agreement. There had in the previous autumn been newspaper rumors as to the formation of a shipping combine under American control, but those rumors had been disposed of by the statements which the press at the time attributed to you. The newspaper rumors did not again assume definite shape until March 24, 1902.

On March 18, 1902, the stockbrokers acting for the trustees replied to the inquiry that had been addressed to them that their clients were prepared to sell at a price they named, subject to the buyer's undertaking to offer all the shareholders to purchase their shares at the same price within a certain period.

It was subsequently pointed out by the legal advisers of the trustees that they were exceeding their powers in imposing any conditions as to shares of the other shareholders, and in consequence the condition had to be withdrawn.

I, having regard to my position as chairman of the company, refused as a trustee of the will to take any part in these negotiations.

As a beneficiary under the will I protested at the time most strongly against the shares being put under offer, and they were afterwards taken over from the trustees, and are now held by myself and other members of the family.

The negotiations thus started on March 3, 1902, for some undisclosed principal were never followed up, but on April 11, 1902, a gentleman who was then, and who is now, asso-

ciated in the management of one of the lines forming the International Mercantile Marine Company wrote to me asking for an interview. I saw him on April 12, 1902. In reply to his inquiries, I told him that I would consider any offer he might submit apart from any consideration of inclination or sentiment, but that whatever terms were offered to any of the shareholders in the Cunard Company must apply to all.

On April 19, 1902, this gentleman saw me again and stated that he had been instructed to indicate a desire to obtain a control of the Cunard Company by the purchase of 55 per cent of the shares at a price which was based on the highest stock exchange price of the shares during the previous 10 years. In reply, I stated that neither the basis upon which this offer was made nor the price indicated commended themselves to me; further, that unless the offer were for the Cunard Company as a whole, I must be satisfied, before placing it before the shareholders, that the proposed combination would have as much interest in keeping up the Cunard Company as in developing any other section of the syndicate.

The gentleman with whom I had these two interviews wrote to me on May 1, 1902, stating that considerable cable correspondence had passed with his friends in America and that he was awaiting a letter. He added that immediately he had anything definite either way he would not fail to communicate with me. I never heard from him again.

These are the only negotiations opened in 1902 with the Cunard Company or its shareholders with which, to the best of my knowledge, the International Mercantile Marine Company were, or might have been, concerned. They were certainly not "lengthy negotiations," and they cannot by any stretch of imagination be described as negotiations which I "conducted in 1902 for the disposal of a controlling interest in the Cunard Steamship Company."

It follows that no feeling of hostility can have been created against the International Mercantile Marine Company from the failure of efforts made by the Cunard Company to enter the combination, because no such efforts were in fact ever made.

You further imply that the Cunard Company having failed to become a party to the combination, is now endeavoring to persuade the public that such a combination is a menace directed against the Cunard Line by reason of its international character.

The Cunard Company have never held this view. They have in the past worked in harmony with their competitors under both British and foreign flags, and they are prepared to work in the same spirit in the future. But they are no less bound to resist any attempt to deprive them of their position on the Atlantic, under whatever flag that attempt may be made.

The announcement made by the German lines in May, 1902, that they had entered into not only a defensive but also an offensive alliance with the companies associated with the International Mercantile Marine Company was a fact which the Cunard Company could not ignore.

When this announcement was followed by action, which we could only regard as the opening of the offensive campaign, we were forced to take such steps as we believed necessary to maintain our rights.

In January this year, after many meetings, you and I were able to arrive at a tentative settlement of all matters then in controversy. To reach such a settlement we made concessions, and in return you agreed, amongst other matters, that the sailing date of the vessels of the American Line from New York, which in 1903 had been altered from Wednesday to Saturday, should be put on some other day, so as not to clash with our regular sailing day. The settlement on all points could only be a tentative one, because you could not agree to change the sailing date without the consent of the American government. It was, therefore, agreed between us

that the settlement was to become null and void unless you were able to carry out your part of the bargain by an agreed date.

Unfortunately you have not been able to obtain the consent, and therefore the settlement tentatively agreed on has fallen through. We were not entitled to complain, and we have never complained, in any way of your inability to carry out your part of the proposed settlement because the possibility of such failure was before us both when the terms were arranged, and it was accordingly agreed that the settlement should be treated as null and void in the events which have happened. On the other hand, you are most certainly not entitled to allege, in the face of the terms we agreed to accept, that we have shown a determination to continue the controversy at all cost.

I cannot understand how the arrangement of sailing dates made in 1885 to which you refer can have any bearing on the question now under discussion, which is simply the question of how we are to receive the considerations which were to be given to us under the terms tentatively settled in January last.

In regard to the negotiations in 1896 to which you refer, I can only state that I know nothing about them.

I, however, see nothing to be gained by following you in the discussion of the details of our business differences. In agreeing to the terms we showed our readiness to settle on business lines the matters in difference, and surely you cannot have expected us to perform such of the terms of the settlement as were imposed upon us whilst you were unable to fulfil one of the most important of the conditions which was to be performed by you.

This is the position, and in the face of the facts, which I am quite content should speak for themselves, it is idle to represent us as the aggressors, or to imply that our actions are inspired by feelings of hostility towards the International Mercantile Marine Company, or that any such feelings stand in the way of our arranging with our competitors a settlement of all matters in difference on business lines.

Your letter was, I understand from you, published without your knowledge and against your wish, but as it has been published I am compelled to send a copy of this reply to the newspapers.

Yours very truly,

INVERCLYDE.

A METHOD OF PREVENTING VIBRATION IN STEAMSHIPS*

By A. Mallock.

A considerable number of papers relating to the vibration of ships have been read before this institution, and in them methods have been given for designing engines which shall be properly balanced. No doubt, to have each engine properly balanced is the right and most desirable thing, if it can be done without interfering with its working in other respects.

The present note is merely to point out that in twin-screw ships, no matter how much the engines individually are out of balance, freedom from vibration in the ship can be secured if the engines are constrained to run at the same speed and in opposite phase to one another. I have often, in reports on such subjects, referred to the complete absence of vibration in twin-screw vessels, when the phases of the engine are opposed, as an illustration of the fact that properly applied balance weights would prevent vibration altogether, for in this case the moving parts of each engine act as balance weights to the other, and if any method could be found of keeping the relative phase of the two engines constant no other balancing would be required. Of course, it is impracticable to connect the engines by gearing or any equivalent mechanical device. Any connection between the two engines, if the method is to be a practical success, must be applicable at will and capable of being removed with ease without stopping the engines or

Paper read at the spring meetings of the Institution of Naval Architects, April, 1905.

interfering in any way with their separate working when removed.

All this might be done with a governor of the form suggested diagrammatically in Figs. 1 and 2. A and B and C C' are a set of differential wheels, of which A is driven by the port and B by the starboard engine. The axes of the intermediate wheels C C' are fixed to the shaft E, which carries the eccentric F from which the valve G is worked. As long as A and B revolve at the same speed the shaft E remains stationary, but it rotates if the speeds of A and B differ. The valve at G is made so that if the shaft E, with its eccentric F, moves in either direction from some assigned position, owing to a difference of speed between A and B, high pressure steam is admitted to the low pressure cylinder of the engine, which has the lesser speed until the valve and eccentric resume

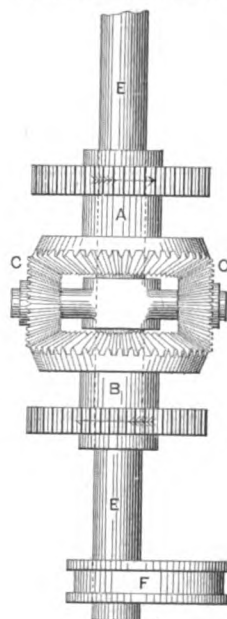


Fig. 1

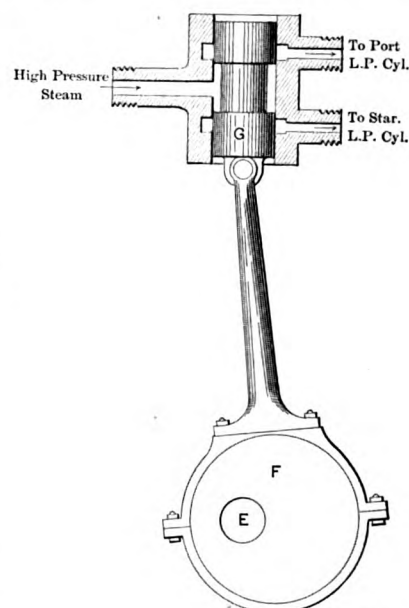


Fig. 2

their original position. The steam pipes required for this purpose would be very small. By cutting off the steam supply to G the governor would cease to operate, and the engines would then be absolutely independent.

I have had a recent experience, on one of the largest of the Cape liners, of how annoying an intermittent vibration can be. In the ship in question the vibration was horizontal, and the engines were generally running at speeds differing by something less than a revolution per minute. Thus during intervals of rather more than a minute the vibration would cease and again rise to a maximum, and while being kept awake from this cause I had plenty of time to think if no remedy could be found less drastic than altering the engines themselves. I believe that the plan now sketched would be effective, and the cost, even for the largest ship, would be reckoned in hundreds rather than in thousands of pounds.

Major J. G. Warren, government engineer at Milwaukee, recently opened bids for improving Milwaukee harbor. The list of bidders follows: Powell & Mitchell, Marquette, \$129,697.70; Bennett & Schnorbach, Muskegon, \$137,689.49; John E. Hathaway, Milwaukee, \$131,150; Rudolph S. Blome Co., Chicago, \$132,082.13; Edward Gillen, Racine, Wis., \$129,336.44; Adolph F. Bues, Milwaukee, \$118,684.96; Great Lakes Dredge & Dock Co., Chicago, \$129,837.88; William H. Gillen, Milwaukee, \$111,695.70.

The steamer Tampa whose low pressure engine was partially disabled by the breaking of her crank pin was towed down by the City of Berlin and will go to Toledo for repairs.

PROPOSED SHIP CANAL TO THE OHIO

The chartering of companies in Ohio and Pennsylvania for the construction of a ship canal from the mouth of the Beaver river in Pennsylvania where it flows into the Ohio at a distance of about 28 miles from Pittsburg, to Lake Erie, now practically insures the carrying out of a project suggested and attempted fifteen years ago. The canal is to have a depth of 12 ft. and ore is to be shipped from Lake Erie to the furnaces located in the Mahoning and Shenango valleys and the Pittsburg district, while the return cargoes will consist principally of coal and coke, the latter for furnaces in these two valleys and for furnaces at Lake Erie ports.

The route of the canal is now being surveyed and the lake outlet has not yet been definitely decided upon. The cost of the canal is estimated at \$25,000,000 and the promoters believe that it can be completed in five years. As the barges to be operated will draw close to 12 ft. the pools in the Ohio river between Pittsburg and Beaver and the lower pools on the Monongahela and Allegheny rivers will have to be increased to a similar depth from 9 ft. as now provided. The cost of deepening the pools would not be excessive and the present locks and dams with slight modifications could readily accommodate these barges. Whether the government would make an appropriation for these changes is doubtful as the canal is projected by private interests, and the communities benefited would be asked to share at least a portion of the cost of the changes.

The company chartered in Pennsylvania and known as the Ohio & Pennsylvania Ship Canal Co. has an authorized capital of \$2,625,000 of which \$600,000 has already been subscribed. The incorporators are E. J. Lloyd, George A. Kelly Jr., William I. Jones, Henry Buhl Jr., Thomas P. Roberts, William J. East, George W. Stewart, Emil Swenson, Charles A. Fagan, George M. Lehman, James W. Wardrop, Burd S. Patterson and John E. Shaw, all of Pittsburg. The officers are John E. Shaw, president; George A. Kelly Jr., vice president; William I. Jones, treasurer; Burd S. Patterson, secretary; George M. Lehman, chief engineer.

In the erection of the canal from Beaver Falls to Lake Erie a rise of more than 300 ft. will be encountered, or about equivalent to that present in the Welland canal. This rise will be mastered by the construction of seventeen locks. Nothing definite can be learned from the promoters as to the size of the locks, possible route, etc., but it is probable that the one surveyed some years ago will be followed as nearly as possible. This lay along the Beaver river to the Mahoning river to Youngstown and Niles and from the latter place almost straight north to Lake Erie the terminus being near Ashtabula harbor. The route from Niles to Ashtabula is slightly less than 53 miles. It is estimated that the saving on ore from Lake Erie will amount to 77 cents a ton to Pittsburg district points and 72 cents a ton on coal to Lake Erie. A bond sale is of course included in the scheme and the communities that will be greatly benefited by the project will no doubt lend their financial support.

W. C. Jutte, one of the leading Monongahela and Ohio river coal operators and who also operated a large number of steamers and coal boats from Pittsburg, committed suicide at Atlantic City on Thursday, May 25. Deceased recently met with severe business reverses and this resulted in a nervous breakdown and this no doubt prompted the suicide. Mr. Jutte was the son of C. Jutte, one of the pioneer coal operators of Pittsburg and one of the most prominent factors in the Ohio river trade. He was born 45 years ago, and early in life became identified with his father under the firm name of C. Jutte & Co. Upon the organization of the Monongahela River Consolidated Coal & Coke Co. the coal and river interests of C. Jutte & Co. were sold to this consoli-

dation, about \$1,000,000 having been secured from the property. He was later instrumental in organizing the People's Coal Co. and was also connected with a large dredging company operating in the Pittsburg Harbor. He is survived by his wife and six children.

Bids for the construction of Lock No. 3 at Elizabeth on the Monongahela river were opened this week by Major W. L. Sibert at Pittsburg. The Dravo Contracting Co., Pittsburg, submitted the lowest of four bids offering to contract for the entire work for \$256,000. The bids were submitted to the war department with Major Sibert's recommendations and the Dravo Contracting Co. will without a doubt be awarded the contract. Work will be commenced as soon as the decision of the war department is received.

The board of United States engineers appointed to report on the advisability of canalizing the Ohio river to a depth of 9 ft. will meet in Cincinnati on June 7. The members of this board recently appointed consist of Lieut. Col. Daniel W. Lockwood, Lieut. Col. E. H. Ruffner, Lieut. Col. Clinton B. Sears, Major George A. Zinn and Major William L. Sibert. It will be the duty of this board to ascertain the approximate cost of canalizing the Ohio to a six and nine foot depth together with the cost of maintenance. A feature of the inspection will be an examination of the Ohio from the mouth of the Green river to Cairo, Ill., to ascertain whether an increased depth of water cannot be secured by means of dredges. If this can be done successfully the cost of building locks and dams on this section will be eliminated and the entire cost of the improvement will be greatly reduced.

Mr. E. B. Wheeler who was formerly a draftsman at the Cleveland office of the American Ship Building Co. prepared the plans for No. 17m, a submarine boat ordered by the United States government. The plans were adopted by the government without a change. Mr. Wheeler is now with the Electric Boat Co. of Bayonne, N. J.

The control of the pilots belonging to the port of Montreal has passed from the harbor commissioners to the department of marine which has decided to form a board of three members to manage the pilotage matters affecting the port. Com'dr Spain will represent the department, A. A. Allan the shipping federation, and L. Gauthier the pilots.

Major J. G. Warren, corps of engineers, with headquarters at Milwaukee, recently opened bids for dredging Gladstone harbor. The bids were: Samuel O. Dixon, Milwaukee, \$11,475; Great Lakes Dredge & Dock Co., Chicago, \$14,025; Greiling Bros., Green Bay, Wis., \$11,262.50; Joseph Wolter, Sturgeon Bay, Wis., \$11,050.

The wrecker Favorite has gone to the stranded steamer W. P. Rend ashore on Manitou Island. The latest reports indicate that the condition of the Rend is not hopeless. The Rend was formerly the G. G. Hadley. Three years ago she sank the whaleback steamer Thomas Wilson in a collision near Duluth.

PROPOSAL.

PROPOSALS FOR CONSTRUCTING BREAKWATER.—U. S. Engineer Office, 262 Huron street, Cleveland, Ohio, May 31, 1905. Sealed proposals for reconstructing and repairing parts of the west pier at Lorain harbor, Ohio, will be received at this office until 2 p. m., June 20, 1905, and then publicly opened. Specifications, blank forms and all available information will be furnished on application to this office. DAN C. KINGMAN, Lieut. Col., Corps of Engineers, U. S. A.

EMANCIPATION OF THE WATERWAYS*

By Lewis M. Haupt.

Probably no expenditure made by the government produces a larger return than that for the development of our waterways. They are the lines of least resistance but in a state of nature they are not always available. Their economic possibilities are inestimable, when not obstructed by bars or tolls. By the improvement of the channels connecting the Great Lakes to a depth of 20 ft., not only has the cost of the transportation been greatly reduced but the enormous stimulus given to manufacturers has added largely to the population and wealth of the cities encircling these waters. Thus the rate on a bushel of wheat from Chicago to New York by the lakes and Erie canal, in 1866, when the Sault canal depth was limited to 12 ft., was 29.62 cents, whereas the rate on a 20-ft. draught in 1904, was only 4.71 cents, or only about one-sixth, thus effecting a saving of 84 percent. The rail charges between the same terminals were, for the year 1866, 32.79 cents, and in 1904, 11.11 cents, showing a reduction of about two-thirds in the charges by rail. From these significant figures it appears that while the charges by rail and water had both been greatly reduced, in 1866 the water charge was 90 percent of that by rail while in 1904 it was only 42 percent.

But a still more impressive illustration as to the beneficial effects of this improvement is set forth by the statement made in 1892 by Senator Wm. P. Frye, in presenting his committee report, wherein he said that for the year 1890 "the total expenditure for water improvements of the lakes has amounted to about \$30,000,000, or approximately one-fifth of the annual saving effected in transportation. * * * Our waterways have acted as the most powerful of regulators of rates. * * * When it is considered that a diminution of one mill per ton on the railroads of the country effects a saving of nearly \$100,000,000 to the shippers in transportation, the value of this restrictive power cannot be overestimated." Had the distinguished Senator added as a recognized fact that such regulation by water does not reduce, but greatly increases the revenues of the railroads he would but have emphasized the commercial paradox, which comparatively few persons appear to recognize.

In 1890 the unit rate by rail was about 9 mills and by the lakes alone was 1.2 so that the computed saving on the tonnage moved by water that year was \$147,027,514. Applying the same method to the tonnage and rates of 1903 it is found that the water rate is about 6.7 mills less than that by rail while the total ton-mileage of the lakes is 28,974,660,408 so that the economy effected for the year 1903 is about \$194,139,206. Attention is directed to another impressive result of the deepening and enlargement of the capacity of the channels, in the greatly increased size, tonnage and economy of operation of the vessels engaged in this traffic. Thus from 1855 to 1883, or during the 26 years when the draught was limited to 12 ft. the traffic increased from 105,296 to 2,042,259 registered tons, giving an average increment of 56,918 tons per annum. From 1883 to 1896, when the Weitzel-Lock was in operation, with its 16 ft. depth, the annual increment was 935,211 tons and after the opening of the great Poe-Lock in 1896 it immediately expanded to 2,750,000 tons so that the registered tonnage in 1902 reached the unprecedented total of 31,955,582, in the seven months of open navigation. Again the value of land is affected by its earning capacity as measured by the price of its products on the spot and this in turn is a function of the cost reaching the ultimate consumer.

Thus the effects of the cheaper water routes manifests itself most remarkably, as will be seen by reference to the average values of the farm products of the several states as furnished by the department of agriculture. From the statistics covering a decade, it is found that the lowest average price for wheat is in Nebraska and that it increases in value as the

*Read before the American Philosophical Society.

seaboard is approached. The difference in price between the 50.9 cents per bushel in Nebraska and the 78 cents at New York, 1,214 miles distant, is 27.1 cents per bushel or \$8.94 per ton which gives 7.2 mills for the ton-mile rate which is just the average for the United States, so that the price on the farm in Nebraska is regulated by that at the port of export, less the freight charges.

In Missouri where wheat may be shipped by the Mississippi river to New Orleans from St. Louis, 1,162 miles for 4.88 cents per bushel or \$1.61 per ton, the rate becomes only 1.4 mills by water. If sent to New York by rail, 946 miles, it is 6 mills per ton-mile. In consequence of this possible competition therefore the average price paid to the Missouri farmer is 10 cents a bushel higher than that paid in Nebraska and this at 12 bushels to the acre means a net return of \$1.20 per acre on his crop.

Extending this analysis to the cereals of the two adjacent states of Kansas and Nebraska the former having the advantage of greater proximity to the waterways, for the year 1901 it was found that the 5 cents higher price realized in the wheat crop, gave to Kansas \$4,953,965 greater revenue than her neighbor, while at nine cents more per bushel on corn her advantage was \$5,535,543, and for oats at six cents, it was \$1,039,944, making a total of \$11,530,000 on these three cereals. In the same manner it is found that if Nebraska could have marketed her grain at Kansas prices she would have received \$14,267,000 more, in one year. The total expenditures of the rivers and harbors of the country up to September 19, 1900, is reported to have been \$370,411,124.44, 4 percent of which would represent the annual loss to one state due to the absence of water competition.

THE POLICY OF OTHER COUNTRIES.

It is not surprising therefore that in the sagacious French Republic which has expended over \$700,000,000 on her internal waterways, which are free of tolls, her economists believe this policy to be fully justified by the indirect returns and the thrift and prosperity of the people incidental thereto.

So too the Dominion of Canada has not hesitated to provide the munificent sum of \$95,316,910.07 for her system of internal waterways, which have returned only about one-eighth of this sum, yet the government recognizes "that waterways and roadways are essential to the commercial life of the country."

Great Britain has learned from a sad experience that the purchase of 1,138 miles out of a total of 3,906, by the railroads, up to 1883, has so retarded her trade that she is no longer able to compete successfully with her foreign rivals and parliament has prohibited the further control of the waterways by hostile interests and is returning to the policy of rehabilitating them under corporate management. Moreover it is shown that the 2,768 miles under independent control, in 1898, earned a net profit of \$1,080 per mile while the returns from the 1,138 miles, managed by the railroads, only averaged \$200 per mile. To secure the rights and privileges of an open port the Manchester district contested for enabling legislation for five years at a cost of \$750,000 against the allied interests of the railroads and the port of Liverpool but now that the great work is completed, at a cost of about \$75,000,000 the 13,000 vacant dwellings and factories are filled and as many more have been added to the district, while the interests formerly opposed, on principle, are all doing a much larger business than before.

Belgium, but little larger than Vermont, has 1,300 miles of waterways of which the center is Antwerp. Notwithstanding the fact that the state owns most of the railways it has encouraged the construction of the canals so as to render the transportation "as cheap as possible, that by this means the Belgian manufacturer may be enabled to compete on most advantageous terms with his foreign rivals." During the last 25 years about \$90,000,000 have been spent on ports and canals, so that goods can be carried in 300-ton barges directly from

the factory to the ship and by the economies thus effected the manufacturer can underbid his foreign competitor.

Germany is building an extensive system of canals to connect the Rhine with the Vistula, passing through her national capital. Russia is urging a 1,000-mile canal to unite the Baltic and Black seas. France is proposing further extensions to her ample facilities and intends making a seaport of Paris. Austria and Italy are also expending large sums for the benefit of their trade with foreign countries and yet the astute American who is on the alert for the best and most economic administration apparently fails to appreciate the great utilities and possibilities lying almost in a state of nature, at his very doors.

POLICY OF THE UNITED STATES.

As evidence it is necessary to refer to the condition of the canals of this country today as compared with those of the past century. Massachusetts claims the honor of building the first canal around the falls of the Connecticut in 1792-3 and the first railroad at Quincy in 1827, thirty-four years later. During this period a large number of canals were incorporated to connect navigable waters, and the discovery of hard coal in eastern Pennsylvania in 1792 also stimulated the opening of canal routes to the great cities of the seaboard and for its transportation to the manufacturers. Thus the Delaware & Hudson, the Morris & Essex, the Schuylkill Navigation, the Chesapeake & Ohio, the Delaware & Raritan, as well as the James River and Kanawha, the Pennsylvania, the Schuylkill & Susquehanna and the Erie were well under way or completed prior to the advent of railroads; but it soon after became apparent that a railroad constructed by private capital could not conduct a profitable business as a competitor of a free waterway built and operated by public funds, so that a war of extermination began between these interests and it became necessary to purchase or lease the canals to control their tonnage. Instead of enlarging and modernizing them for the interest of the lessees and the public they have in some cases been abandoned and in others only sufficient traffic is carried to maintain the charters. The result of this policy is well illustrated in the history of the state works of Pennsylvania where between 1865 and 1874 some 701 miles of canals, which had cost over \$33,000,000 to build, were abandoned. In a similar way 656 miles of the Ohio canals were obliterated, having cost nearly \$11,000,000. New York has been more fortunate in having lost only about 269 miles which cost something over \$10,000,000, but the determined effort now making to prevent the enlargement of the Erie canal to even 12 ft. depth indicates that the active opponents to our waterways are not yet convinced that their best interests are conserved by these great arteries of cheap transportation. The beneficial effects of the cheapest water competition in the country upon railroad interests may be seen along the Great Lakes where the roads skirting their banks are amongst the best revenue producers in the United States. If it were possible to purchase the 90,000 square miles of non-productive water-surface and convert it into arable land the railroad interests would not permit it to be done as it would exterminate the prosperous cities and industries which these waters have created, and ruin the tonnage incidental thereto, yet they persist in obstructing deep water legislation. By the end of 1835 there were about 2,700 miles of canals open and in use and only about 1,000 miles of railroad; in 1889 the canal mileage had fallen to 2,305.2 while the railroad mileage had increased to 157,976 miles and today it is not less than 212,000. Of the canal mileage only 40.6 is under the control of the general government and 2,264.6 is under state or corporate control. This does not include the 1,078 miles of slackwater improvement, making in all only about 3,400 miles for the entire internal water-borne commerce of the United States.

What this indifference to the earning capacity of canals means in the cost of wear and tear, for maintenance, may be well ex-

emplified by a comparison of the reports of the United Railroads of New Jersey for the best year of the canal traffic before it was leased by the railroad, and when its traffic reached nearly 4,000,000 tons per annum.

In the reports of the company for the year 1866 it is stated: The cost of the Camden and Amboy R. R. and its

equipment	\$10,099,000
The cost of the canal and appurtenances	4,381,251
The cost of operating the railroad for the year was	3,801,732
The cost of operating the canal for the same period	360,513
The net revenues from the railroad were	511,162
The net revenues from the canal were	933,642

So that the railroad returned a little more than 5 percent while the canal earned nearly 23, and the operating expenses were less than one tenth of the former. This financial statement is independent of the general benefit conferred upon the public at large by the lower charge for freight carried.

From the above statements as to the great economic advantages of canals, the neglected condition of our own and the activity shown in foreign countries which are thoroughly alive to their importance, it would seem incredible that this government has failed so frequently to act upon or authorize others to engage in most laudable projects, which call for no appropriations from the general treasury for construction, and that petitions of influential communities and large industrial centers are set aside on the score of economy or for other pretexts so that these most important economies in interstate traffic are prevented from securing legislation for periods varying from ten to twenty or more years. Some of the most worthy projects have been before congress for nearly a half century and do not appear to be much nearer fruition than when they were first proposed.

THE OHIO RIVER.

The largest manufacturing district in the world, that at Pittsburgh, has been praying congress for a charter to construct a ship canal to connect the Ohio river at Beaver with Lake Erie at Ashtabula, so that the congestion of the trade in coal, iron and steel may be raised and the price of these commodities be reduced, but in vain. In this district the annual tonnage now exceeds 86,000,000 which is greater than that of any port in the world, and the great rivers leading to the sea are not yet navigable for boats of even six feet draught. They must wait for floods to float them to the markets. What this means may be best shown by the experience of the season of 1895 when the coal which had been accumulating from April 18 until Nov. 28, seven months, and which amounted to 1,200,000 tons was providentially released by a flood only in time to prevent it being frozen in and a large part of it lost. As it was, the cost of keeping the barges afloat amounted to \$2,000 a day. The value of the plant thus tied up was estimated at \$6,500,000.

Although the improvement of this river has been discussed, surveyed and frequently reported upon, the first dam, that at Davis Island, was not opened until 1885 and since then another, at Beaver, has been completed, twenty-eight miles below. Four above and five below Beaver are under contract, but it is estimated that between Pittsburg and Cincinnati thirty-seven locks and dams will be required and fourteen more below Cincinnati; all for a six-foot navigation, but already it is found insufficient and nine feet are now required. At this rate it may well be asked when will the 1,000 miles be available? This is all down grade and amongst the cheapest systems in the world—on a six-foot draught the estimated cost is .675 mills per ton-mile and on a nine-foot, .39 mill. The lowest rail movement is believed to be that across the lake divide, on the Bessemer and L. E. R. R. where the charge was 1.87 mills in 1901, and 2.10 mills in 1904—or three times the river rate.

THE COASTWISE CANALS AND PRIVATE ENTERPRISE.

Again for more than twenty years urgent demands have been made for the creation of harbors of refuge along the New Jersey coast, where there have been 368 wrecks in ten years which is recognized as one of the most dangerous on

the great bay between Cape Cod and Cape Hatteras, but while several estimates have been submitted for projects costing from three to four millions each they have been rejected as unworthy of improvement because of the absence of sufficient local commerce, caused by the existing bars which it is desired to remove. The interior coastwise canals have been recommended for about a century, but as yet only a few links have been built and those mainly by private and state aid. Massachusetts, has authorized private companies to open a canal across Cape Code; New Jersey, across its girdle; Delaware and Maryland through their peninsula; Virginia from the Chesapeake to Albemarle Sound; South Carolina from the Santee to the Cooper rivers twenty-two miles, opened in 1802; and many others. The state of Illinois has authorized the levying of a special tax which has been expended in cutting the Chicago drainage canal through the sag to the Illinois river. Thus past history and present experience point conclusively to the greater efficiency of the policy of constructing local works under local legislation and supervision rather than to attempt to legislate for the entire country, by general appropriations made in congress where so many other matters of a political nature consume time and prevent action, or where sectional jealousies have operated to restrain important measures. Even at this date there are said to be works recommended for approval aggregating nearly \$500,000,000, in rivers and harbors alone, to meet immediate demands, yet it is extremely difficult to pass a bill for even the most urgent improvements. So that it has recently been deemed necessary to authorize private parties, corporations or municipalities to make their own improvements at their own cost subject to the approval of the plans by the government, but without authority to charge tolls, or to collect revenues. As this is not a practical, commercial proposition, it has been further amended, in the last act, by giving authority in several special instances to private individuals to open channels and charge tolls, the government reserving the right to recover control after a period of years.

Thus the pressure for commercial channels which it is beyond the power of the general government to furnish in a reasonable time, is leading back to the original policy of local control and development of the lines of least resistance for our internal commerce which has done so much to open up the country prior to the destruction of our merchant marine in 1867 when it was the pride of the nation, and mistress of the seas.

If the government desires to adhere to the policy of expending 75 per cent of its revenue for the war, navy and pension establishments it would seem to be wise to surrender its jurisdiction over the secondary rivers and harbors, to local or state authorities that there may be opportunities afforded for the creation of channels of ample capacity not only for commerce but also for the use of the military and naval arms of the service in case of necessity that they may be operated on safe strategic bases between naval depots. Thus may the waters of the country be emancipated from the shackles which have so seriously retarded their development.

The steamboat inspectors throughout the country are now busily engaged in testing life-saving equipment on passenger boats and are making thorough examinations of the boats themselves to see that the regulations governing construction are complied with. Modern practice has made a great many of these regulations useless, but nevertheless they are faithfully observed. For instance, on the Anchor liner Juniata the steam pipes are according to law lead into the lamp room, notwithstanding the fact that there is absolutely no possibility of a fire spreading from this room, for it is of fire proof construction throughout and a fire could by no possibility spread from it.

ELECTRICAL DEVELOPMENT IN SHIPYARDS

By George E. Walsh.

Within ten years the power equipment of the English and American ship yards has been completely revolutionized, and electricity today performs the work that steam and compressed air monopolized prior to 1895. The cost of changing the motive power of the ship yards has been enormous, but in spite of this the saving effected has proved a satisfactory justification for the improvement. As the result of the concentration of all the generating plant in one building, it is possible to utilize a cheaper grade of fuel than when each individual steam engine had to supply power for isolated units. The saving in fuel, labor, and cost of distribution represents items of great importance. The electric power in ship yards has demonstrated probably more than anything else the very wasteful practice of using long lines of steam pipes for supplying small engines scattered throughout a large area.

With the satisfactory adoption of electric-driving for ship yard purposes, the question of further improvements to lessen cost and increase efficiency is now paramount. There are certain tendencies in this practice which indicate the line of improvement that can shortly be developed. Both in American and British ship yards three different electrical systems have been on trial the past few years. One is the employment of a low continuous current not exceeding 125 volts. This practice is now being abandoned for a higher voltage where the pressure runs from 220 to 250 volts. The very latest installations are the three-phase alternating current of 400 to 440 volts pressure.

The use of the latter system has become more general than the direct current, and its development is proving more satisfactory each year. In ship yards where a higher pressure than 250 volts is required the advantages of the three-phase current over the continuous-current are quite apparent. The cost of maintenance of the two systems is nearly the same, although the continuous-current plant may show some slight advantage in this respect owing to the small amount of attention required for the commutators and brushes.

The advantages of the flexible nature of electrical power plant are important in modern ship building owing to the rapidly increasing difficulties encountered in fitting out ships. The size of the ships have steadily increased in the past few years, and the extra fittings of the interior have multiplied so fast that the burden on the ship builder has grown proportionately. In most ship yards where the average size of a ship turned out ten years ago was 320 ft. by 40 ft., the average today is from 450 to 500 ft. in length, and 50 to 60 ft. beam. The tendency is to increase this average instead of reducing it. But the extra fittings of the ship are even greater in proportion than the increase in size. Mechanism never dreamt of a few years ago have become necessities today, and the construction and fitting of these requires new machinery and a more mobile plant.

The electric drive has made it possible for ship builders to keep abreast of the times in constructing the ship appliances and equipments without materially increasing the cost. It would be difficult to solve many of the problems of ship construction today without the employment of the electric motor. The cargo-handling equipment of the modern ship is a most effective mechanism, and the tendency is to improve it so that it will save time and labor. Likewise the development of lighting systems, steering arrangements, and ash-hoists on ship board all entail extra mechanical work in the ship yard.

The development of electrical machinery in a ship yard is of importance. Economy and efficiency are aimed at in designing tool machines. Punches, shears, plate rolls, winches and cranes have had to increase their capacity to meet the new demands of the larger ships. Punching and shearing

tools are made in all sizes for the modern ship yard, and provision has had to be made to accommodate their service to the higher class of work demanded. Ten to 15 H. P. motors suffice to operate most of these tools, but in the leading ship yards even 20 and 25 H. P. motors have lately been installed for operating punching and shearing tools.

In some of the old ship yards the old machines that were originally driven by steam or compressed air have been changed to suit the demands of electricity. The conversion of these tools and machines from steam to electricity has been accomplished by fixing a motor on the top of the machine to drive a connecting belt. In this way old punches, shears and angle cutters have been utilized without great cost in effecting the change.

Where new electrical machinery is used, the tendency is to make improvements upon the old style machines. This is accomplished in one particular by combining different tools in one machine. This saves time and space in a ship yard, and the tendency is strong to group the machines or to combine several tools in one. We have such instances in the modern electrically-driven horizontal angle punch, beam bender and straightener, and winch all operated by either one or several motors attached to the top. A 15 H. P. motor driven by a continuous current at 220 volts pressure proves a most efficient product of the machine designers in many ship yards. Another combined tool machine driven by a 15 H. P. motor is the punch, shears and double-angle cutter. Like the former this machine proves of great efficiency by virtue of its compactness.

The best illustration of the time and space saved in a ship yard by combining several tools in one machine is found in the modern operation of an angle bar beveling machine. This machine is placed on a narrow gauge tramway, and it travels up and down the yard to handle any number of heated bars from the different heating furnaces. The motor which controls the machine for bending the bars also operates the traveling gear. An electric indicator enables the operator to see exactly the results of his work, and the adjustment of this machine to different kinds of employment is very nearly perfect. This machine must give the necessary bevel to the angle bars in all parts of the ship under construction, and where the frame work is narrow at either end the adjustment of the machine must be very exact. The starting and reversing of the machine easily and skilfully are also important factors in its usefulness. Under electric control this is rendered so satisfactory that a much higher percentage of work is obtained.

The efficiency of electrical-driven machines depends to a considerable extent upon quick and easy control. This factor is unimportant in some of the heavy machines whose work is continuous in one direction, but where frequent starting and reversing are required perfect control is important. This is particularly true in ship building yards in handling the heavy plates and girders. After being machined and prepared by the tools, they must be hoisted quickly to position and often held there in nice adjustment. The development of the modern electric crane and winches has been so radical that an operator without much skill can handle the heaviest angle bars and plates without trouble. Every part of the hoisting machine is directly under immediate control so that an efficient brake can be applied at once and the load released or held in position at the right moment. The time saved by employing the electric hoisting gear in a ship yard thus represents a most important factor of economy. Usually the winch is operated by a series-wound motor so that any speed desired can be obtained, and a good margin of safety is obtained by having the electric brakes reenforced with foot brakes. The electrically-operated winch is portable, and can be moved to any part of the yard as needed, and carrying its own power with it by overhead wires it is always ready for immediate use.

In many minor ways the introduction of electricity in the modern ship yard has developed new features of work that

were formerly done outside entirely. For instance, all the stanchions, rails and other parts of the ship exposed to rust are galvanized in the ship yard by means of an electro-deposition plant. A low-tension dynamo can be utilized for this purpose, and it proves a most economical work. Run at a very low voltage and large current capacity such a machine saves on the cost of galvanizing over the old method from twenty to fifty per cent. A good many parts of the ship that were formerly painted are now treated in this way as the result of this employment of electricity right in the yard. Frequently old rails and stanchions are re-galvanized owing to faulty work or other cause. Likewise faulty castings which reach the yard from the forge require repairs of a minor character. A good many ship building plants have an equipment for performing this work. A low-tension dynamo is used, and with the aid of carbon pencils the flaws and holes of the faulty castings are filled up.

When a ship is built and launched the electric motor comes in for a share of work that was formerly very clumsily handled either by hand, steam pipes or compressed air. The work inside below decks is frequently of a technical nature that requires the use of the best tools. The electrical drive enables the workmen to reach every part of the hull so that skillful results are obtained. Likewise the woodwork of the cabin and deck that must be finished after the ship has been launched can be fitted and built in by the aid of electricity. The portable electric saw-bench for wood working is used for cutting the beams and planks for ceiling and floors. The machine is compact and efficient, and so ingenious in its arrangement that any part of the ceiling can be reached. Wood working machines for deck and cabin purposes are thus coming more into use in the ship yards, and the cutting and fitting of timbers can be accomplished in half the time required by the old method.

Other particular applications of electricity in the modern ship yard are constantly being devised, and the improvements are daily adding to the efficiency of the up-to-date plant. The cost of building ships has increased through the adoption of a great multiplicity of new fittings and devices for economizing in labor and space and to add to the comfort of passengers; but the application of electricity to the work is partly counteracting this steady rise in construction cost. With new developments of electrical machinery, the ship builder finds himself able to cope with new problems that existing conditions impose upon him.

Commissioner of Navigation Chamberlain has ruled that the foreign-built steamship *Peconic* is entitled to American registry. This vessel was built in England in 1821 and on Aug. 27, 1902, was wrecked by collision with the steamship *Laguira* while going down New York bay. The *Peconic* was put in dry dock and repaired at an expense of \$35,590.78. On Oct. 5, 1902, she resumed her operations under her foreign owner and continued so until purchased by Mr. Benjamin H. Timpson on Jan. 18, 1905, for \$34,000. Evidence submitted to the commissioner by W. D. Dickey, manager of the John M. Robins Co., Erie Basin dry dock, Brooklyn, N. Y., by Frank S. Martin, ship and engineer surveyor, and Isaac W. Edsall, Port Wardwell, N. Y., was to the effect that Mr. Timpson paid a full price for the steamer. The commissioner therefore holds that she is entitled to American registry.

Three tugs were recently launched from the yard of Neafie & Levy Ship & Engine Building Co., Philadelphia. Two were for the quartermaster's department and the third for New York tug boat owners. The two government tugs were christened *General R. M. Batchelder* and *General Timothy Pickering*. They are 110 ft. long, 24 ft. beam, 13½ ft. deep and have compound engines with cylinders 18 and 36 in. by 22 in. stroke. Steam will be supplied by single Scotch boilers 11 ft. 6 in. diameter by 11 ft. 6 in. long. The third vessel was named *Protector* and is 112 ft. long, 22½ ft. beam and 10 ft. deep.



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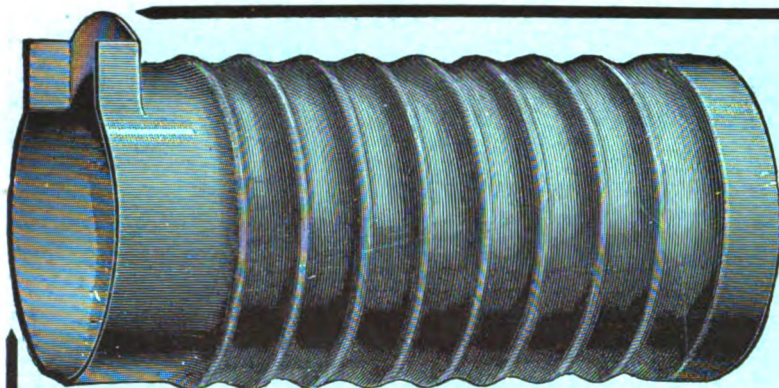
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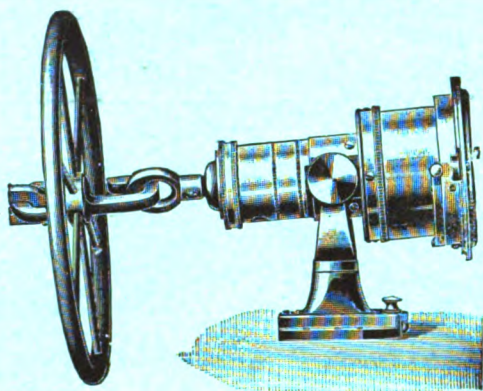
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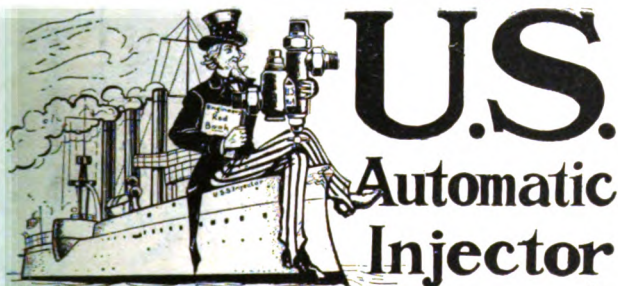
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The T. B. Rayl Co., 112-116 Woodward Ave., Detroit,
J. B. Sperry, Port Huron,
Geo. B. Carpenter & Co., 202-208 So. Water St., Chicago,
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THE STAMFORD FOUNDRY COMPANY, STAMFORD, CONN.



U.S.
Automatic
Injector

On Sea or Land

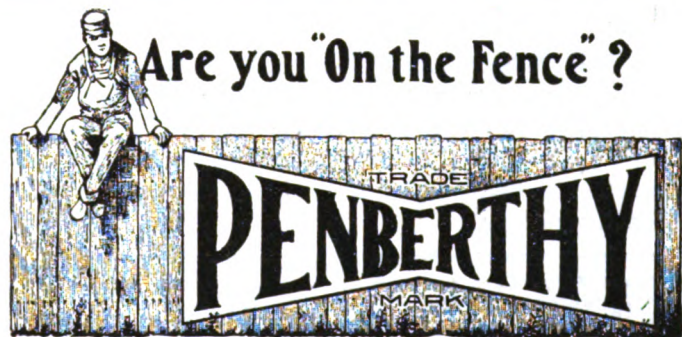
Under all conditions—for marine, stationary, locomotive or threshing boilers—the U. S. Injector is by long odds THE BEST. It is the one perfect Injector. The *U. S. Government* says so—200,000 engineers who use it say so—and use is proof.

It is the stay-satisfactory injector. It always works—never balks—starts at lower steam pressure and works to higher than any other. Combines simplicity of construction and operation with extreme durability and dependability.

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DETROIT, U. S. A.



Are you "On the Fence"?



Don't Buy an Experiment.

THE PENBERTHY
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has for twenty years been the
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PENBERTHY FORCE
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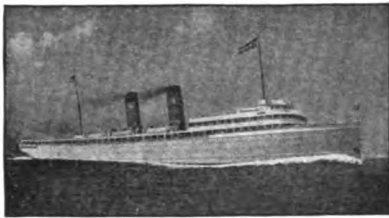
feeds oil to a drop, regardless of temperature. Send for catalog and three months' subscription to the Penberthy Bulletin free.

The Penberthy Injector Co.

Largest Manufacturers of Injectors in the World

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Manufactured in Canada by the Penberthy Injector Co., Ltd., Windsor, Ont.



The American Ship Building Company

MAIN OFFICE CLEVELAND, OHIO

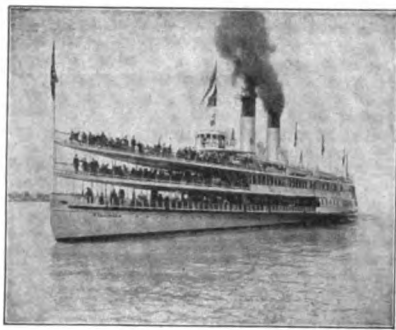
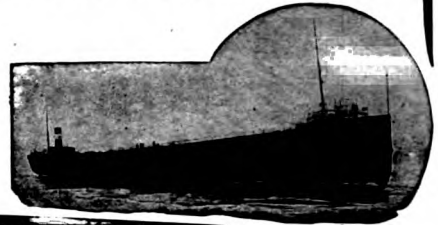
Marine and
Stationary Engines

STEEL SHIPS

Boilers and
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Sole Agents for the Lakes for the Ellis & Eaves Induced Draft System,
as applied to boilers, giving increased power and great economy.

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Sole Owners for the Lakes and Atlantic Coast
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applied to Boilers, giving increased power and
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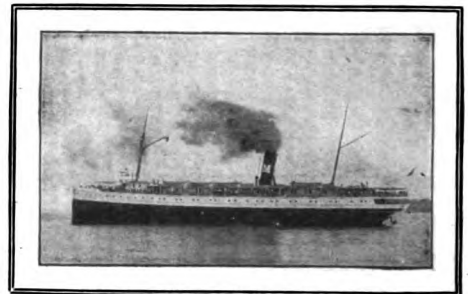
Steel Ship Yard located at Wyandotte, Michigan
Wooden Ship Yards and Dry Docks, Foot of Or-
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Alexander McVittie, President and Manager
William C. McMillan, Vice President
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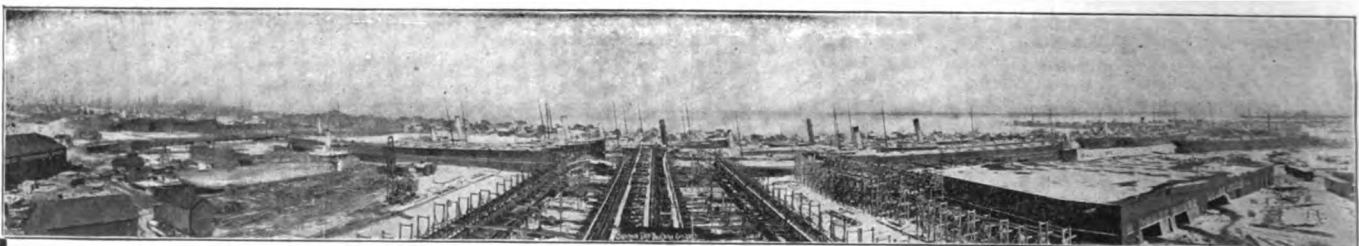


STEEL SHIPS

Passenger or Freight

ANY SIZE

Yards, Dry Docks and Repair
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The Superior Ship Building Company

SHIP AND ENGINE BUILDERS

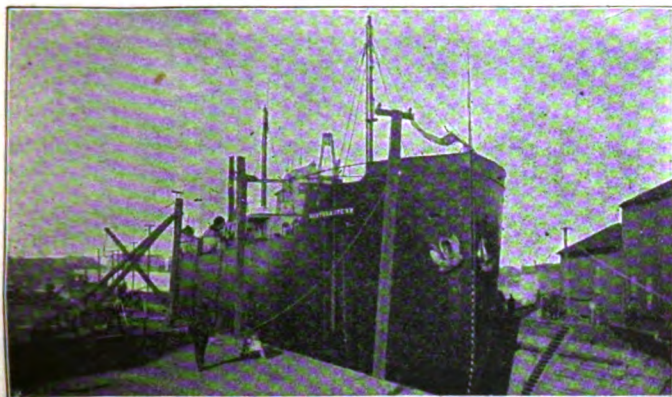
Dry Docks and Repairs of all kinds

Large stock of material always
on hand for Repairing Wooden
and Metal Ships.

Repairing promptly attended
to, Night or Day.

WEST SUPERIOR

WISCONSIN



Milwaukee Dry Dock Company

MILWAUKEE

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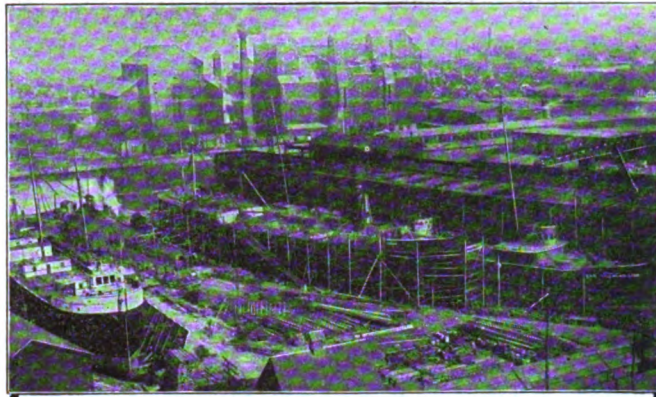
SHIP REPAIRS OF ALL KINDS

We have two ship yards offering every facility for the repair of both steel and wooden vessels. South Yard Dock is 450 ft. long on keel blocks; 460 ft. over all; 60 ft. width of gate and 16 ft. over sill. West Yard Dock is 312 ft. on keel blocks; 45 ft. width of gate and 12 ft. over sill. Rudder pit in each dock.

Electric lights for night work.

MAIN OFFICE AT SOUTH YARD
Foot of Washington Street

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The Buffalo Dry Dock Company

BUFFALO

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Operating four Docks, Sixty-Ton Shear Legs, and in every way equipped with modern plant for the building and economical repairs of **STEEL AND WOODEN SHIPS.**

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Office Telephone, 515 Seneca. President's Office Telephone, 2329 Seneca.
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UNION BONNET

GLOBE, ANGLE, CROSS AND CHECK

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FOR 175 LBS STEAM PRESSURE TESTED TO 250 LBS. HYDRAULIC. CAN BE REGROUND WITHOUT DETACHING FROM PIPE. MAY BE PACKED WHILE VALVE IS OPEN AND PRESSURE ON. ARE EXTENSIVELY USED ON STEAM VESSELS WHERE A PERFECTLY RELIABLE VALVE IS REQUIRED.

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CRANE CO.

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ESTABLISHED 1855

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CRAIG SHIP BUILDING CO.

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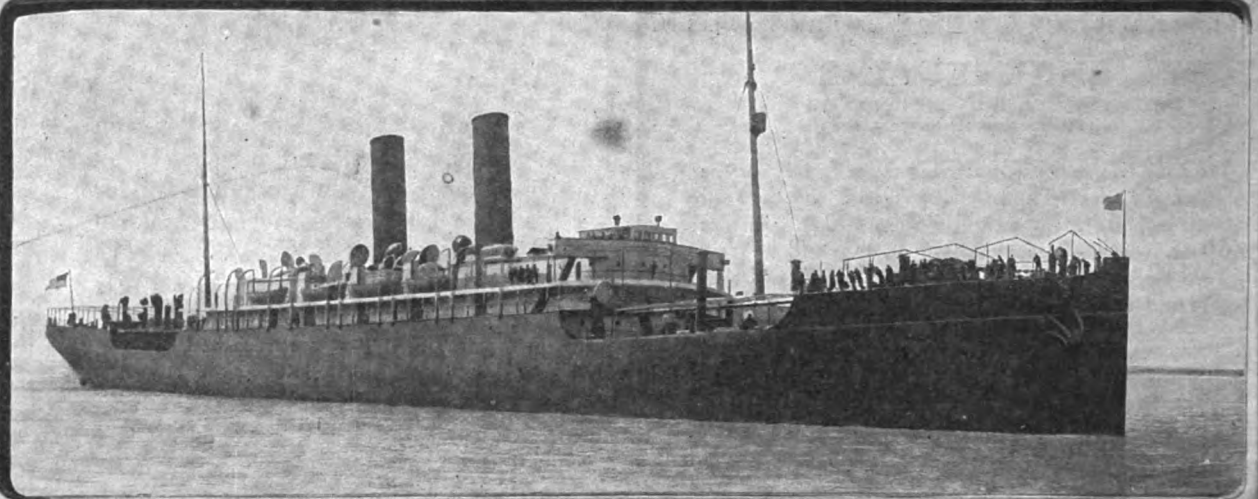
METAL - AND - WOODEN - SHIP - BUILDERS.

New Dry Dock—525 feet long, 110 feet wide on top,
55 feet wide on bottom, 16 feet of Water on Sill.

Repairs to Metal and Wooden Ships
A SPECIALTY.

OUR SHIPYARD

WITH ITS ACCOMPANYING DRY DOCKS
AND WORKS, WAS CAREFULLY DESIGNED,
EQUIPPED AND COMPLETED FOR THE



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BATTLE SHIPS · ARMORED CRUISERS ·
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NEWPORT NEWS SHIPBUILDING & DRY DOCK CO.
1 BROADWAY NEW YORK — NEWPORT NEWS, VA.

After four years of investigation, the Boiler Committee appointed by the British Admiralty have unanimously declared that water tube boilers are more suitable for Naval purposes than cylindrical, and have again placed THE BABCOCK & WILCOX at the head of all types.

THE BABCOCK & WILCOX CO.

NEW YORK and LONDON

Bayonne, N. J., U. S. A.
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WORKS:

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The Only Chain

"as good as"

*a Woodhouse Chain is
Another Woodhouse
Chain.*

Seems strange, perhaps, that one firm should excel in making Marine Chains and other chains when the same materials which we use are used by others.

But knowing how has lots to do with it.

And "knowing how" includes more than the mere practical knowledge of chain-making, for it also includes a knowledge of what is required of certain chains—Crane and Dredger Chains, for instance—and how to meet the requirements.

Try us 'once and see why folks who know swear by the Woodhouse Brand.

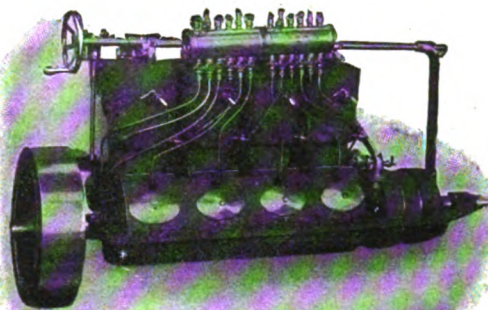
Write us about it anyway.

Woodhouse Chain W'ks,

TRENTON, N. J.

TRUSCOTT

THE DEPENDABLE MARINE MOTOR



Made to withstand the most severe and continuous service. A practical design characterized by the accessibility, compactness and simple ignition, gas producing and oiling features. Perfect control.

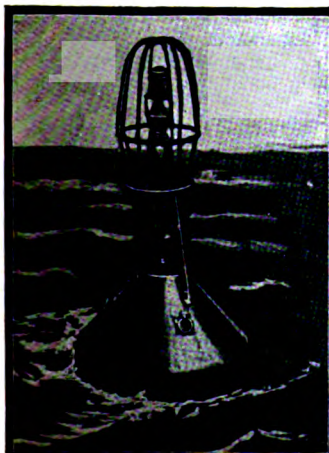
Four cycle type two and four cylinders, from 8 to 65 H. P. Smaller sizes of the two cycle type.

Catalogue and copy of The Launch for the asking.

Department 46.

Truscott Boat Mfg. Co.

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Pintsch Gas Lighted Buoys

BURN CONTINUOUSLY

FROM 80 TO 365 DAYS AND NIGHTS WITHOUT ATTENTION AND CAN BE SEEN AT A DISTANCE OF SIX MILES.

Brilliant & Steady Illumination. Economical & Reliable in Operation.

Adopted by the English, German, French, Russian and United States Light House Departments for Channel and Harbor Lighting; over 1800 gas buoys and gas beacons in service.

Controlled by the

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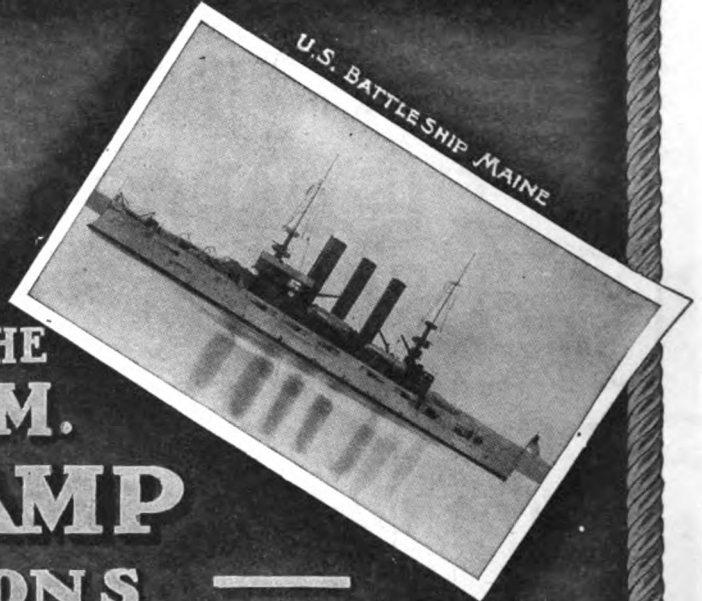
160 Broadway,

NEW YORK CITY.

CLYDE LINE APACHE



U.S. BATTLESHIP MAINE



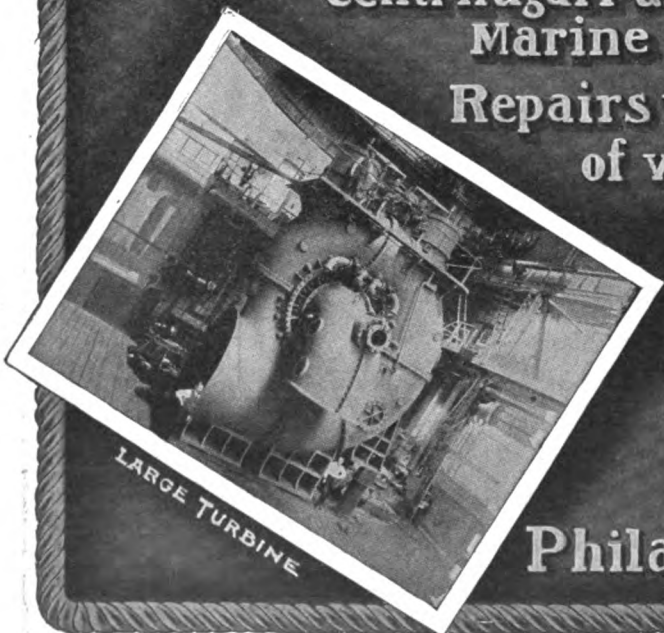
THE
WM.
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SHIP & ENGINE BUILDING Co.
ESTABLISHED 1830

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KENSINGTON SHIPYARD Co

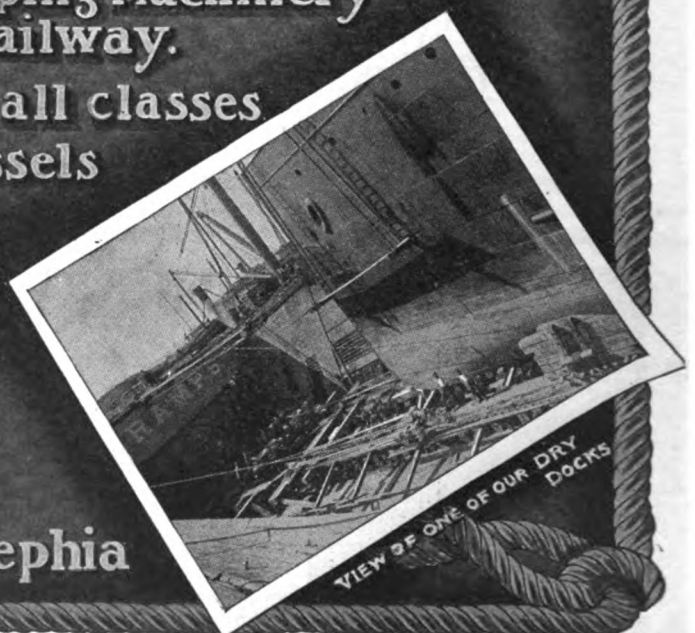
WARSHIPS AND MERCHANT STEAMERS
Pumping, Blowing and Hoisting Engines, Dry Docks
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Marine Railway.
Repairs to all classes
of vessels

LARGE TURBINE



Philadelphia

VIEW OF ONE OF OUR DRY DOCKS



CLEAN BOILERS

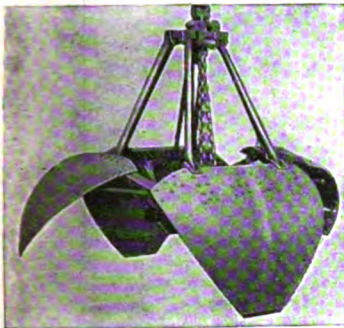
Dearborn Water Treatment made to suit the case. Takes off the scale, keeps it off, stops corrosion and foaming. Send gallon of water for analysis.

DEARBORN DRUG & CHEMICAL WORKS

G. R. CARR,
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16 BRANCH OFFICES IN THE U. S.

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KIESLER AUTOMATIC BUCKETS

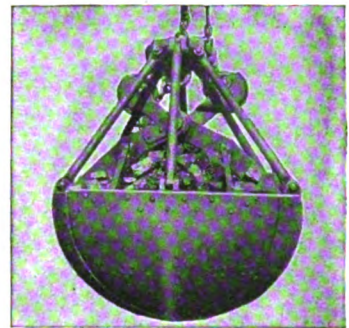
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Open

Orange Peel and Clam Shell Types
for handling Coal, Iron Ore and Excavating

We guarantee our Orange Peel to always fill in large lump Soft Coal and Iron Ore. Has two flat lips and will not damage boats or cars. Are from 30 to 50% lighter than any other buckets. Digging ability due to powerful system of leverage.

Write for Catalogue and Prices.

MAYO & BAILEY 1548 1st Nat'l Bank Bldg.
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Orange Peel Closed
showing load

THE STANLEY B. SMITH COAL AND DOCK CO.,
TOLEDO HARBOR, TOLEDO, OHIO.

1,800 Feet of Dock.

6 McMyler Derricks.

Capacity 3,000 Tons Daily.

Fuel Lighters. —"KANAWHA."
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Docks. —PENNSYLVANIA R. R.
—HOCKING VALLEY R. R.
—TOLEDO AND OHIO CENTRAL R. R.

SMITH'S COAL DOCK, Detroit River, DETROIT, MICH.

12 Pockets.

Platform.

Low Dock.

Operated by STANLEY B. SMITH & CO.

MARINE SUPPLY COMPANY—STORE AND ICE HOUSE ON DOCK.

PITTSBURG COAL COMPANY

GENERAL OFFICE, LAKE DEPARTMENT, PERRY-PAYNE BUILDING, CLEVELAND, OHIO

Steamboat Fueling Facilities at Various Points on the Great Lakes

CLEVELAND HARBOR { 4 Car Dumpers.
3 Lighters.

FAIRPORT HARBOR { 1 Car Dumper.
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DETROIT RIVER BRANCH { Docks and Pockets at
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SAULT RIVER BRANCHES { Dock and Pockets at Detour.
Dock and Pockets at Sault Ste. Marie. (The Port Royal Dock Co.)

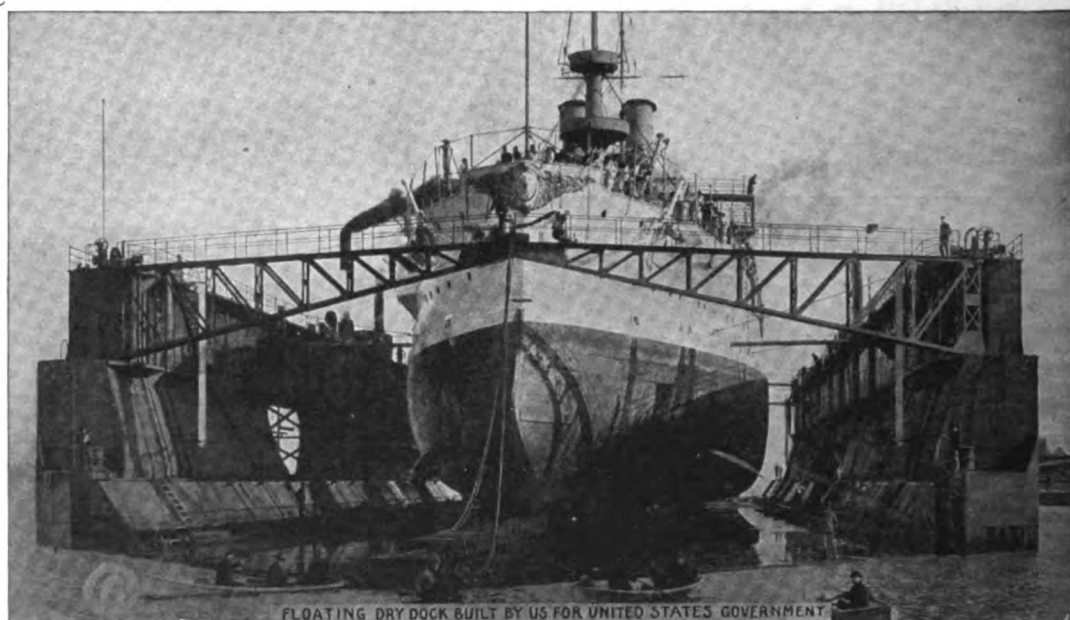
WE FURNISH ONLY THE BEST GRADE OF

PITTSBURG AND YOUGHIOGHENY COAL

MARYLAND STEEL COMPANY

BUILDERS OF STEEL STEAMSHIPS,
TOW BOATS, SAILING VESSELS,
BARGES AND STEAM CRAFT
OF EVERY DESCRIPTION

STEEL FLOATING DRY DOCKS
CAPABLE OF DOCKING
THE LARGEST VESSELS



FLOATING DRY DOCK BUILT BY US FOR UNITED STATES GOVERNMENT

SPARROW'S POINT,
MARYLAND.

The MIETZ & WEISS OIL ENGINES

Two Cycle

Constant Thrust

—Operated by—

Kerosene Oil, Fuel Oil, Distillate or Crude Oil.

Simplest, Safest, most Reliable and most Economical Engines on the market.

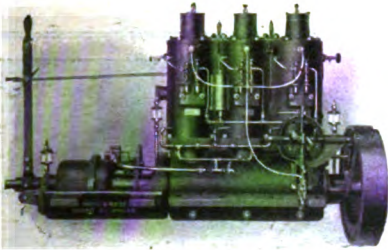
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No Valves, Cams or Gears.
No Electric Sparking Devices.
Automatic Ignition by Compression.

No - Danger-
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used.

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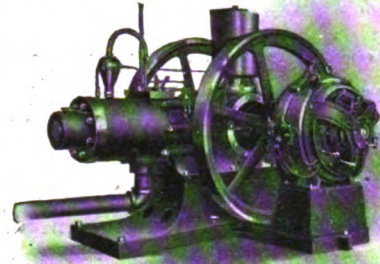
Especially adapted for operating electric
generators for lighting launches, yachts
and house boats. Perfect regulation, great-
est economy
and absolute
safety.



1 to 60 horse power.

See our Exhibit at the
Sportsman's Show, Madison
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March 9.

SEND FOR CATALOG,
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1 to 75 horse power.

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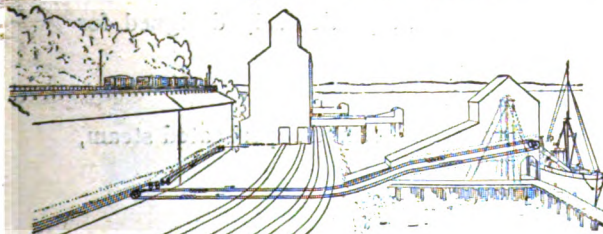
Iron Foundry and Machine Works,

128-138 Mott Street

NEW YORK, U.S.A.



Northern Pacific Railway, Tacoma, Wash. Coal is taken from Bunkers shown at left by Link-Belt Carriers, and delivered into Carrier at right angles running out to sea. This latter Conveyor is carried by hinged Truss. Normal capacity 700 tons per hour.



Northern Pacific Railway Co., Tacoma, Wash.
Loading 700 Tons per Hour

Philadelphia

The Link Belt Engineering Co.

Ship Loading Plants

We Design and Build

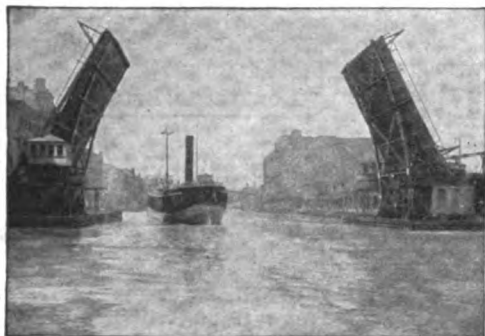
Complete equipments for transporting material of
all kinds from cars to vessels or vessels to cars with
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many of the largest transportation companies in the
world with machinery of this character whereby
the space occupied and the time and labor otherwise
consumed in loading and unloading vessels has been
greatly reduced. We will submit plans and esti-
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We also Design and Install

Machinery of the highest efficiency for HANDLING
MISCELLANEOUS FREIGHT in Steamship Docks
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The Link-Belt Machinery Co.

Engineers. Founders. Machinists. CHICAGO



Modern Highway and Electric Railway Scherzer Rolling Lift Bridge open for the passage of large vessel. Superseded and replaced a center pier swing bridge.

More than **60 SCHERZER ROLLING LIFT BRIDGES**

have already been built, superseding and replacing swing bridges and other old types of movable bridges for railroads, electric railways and highways in the most progressive cities and harbors of the world.

HIGHEST AWARD

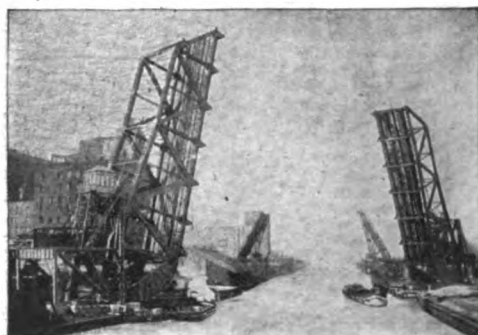
World's Fair, St. Louis, 1904

"Center pier swing bridges form **artificial obstructions**, blocking **navigation** and **commerce**. They are condemned, removed and replaced by modern **SCHERZER ROLLING LIFT BRIDGES** wherever **Manufacturing, Commerce, Transportation, Railroads** and **Ships** are valued, protected and advanced."

Write us for photographs, information, sketches and estimates

THE SCHERZER ROLLING LIFT BRIDGE COMPANY

Main Offices: Monadnock Block, Chicago, U. S. A.



Modern Railroad Scherzer Rolling Lift Bridge in the open position. Longest span Bascule Bridge in the world. Also Highway Scherzer Rolling Lift Bridge open further down the river.

"Wiltbonco" Steam Plant Accessories

Awarded Gold Medal at Universal Exposition, St. Louis, 1904.

REFLEX WATER GAUGES AND WILTBONCO GAUGE MOUNTINGS

Used by all the principal Navies of the world, Merchant Marine, and for Locomotives, Automobiles, Stationary and Portable Boilers.

"THE WATER SHOWS BLACK"
ESPECIALLY ADAPTED FOR HIGH PRESSURE.

CUSHION PRESSURE SEATED CONTROL COCKS For all liquids and gases

"FREEPORT" VALVES For all purposes, but particularly designed for high pressures and superheated steam.

"SAFETY" PLASTIC METALLIC PACKING,

COOPERITE SHEET PACKING, For high pressures and superheated steam, acids, ammonia, etc.

WILTBONCO-HOGAN OIL FILTERS.



The Wm. T. Bonner Co.

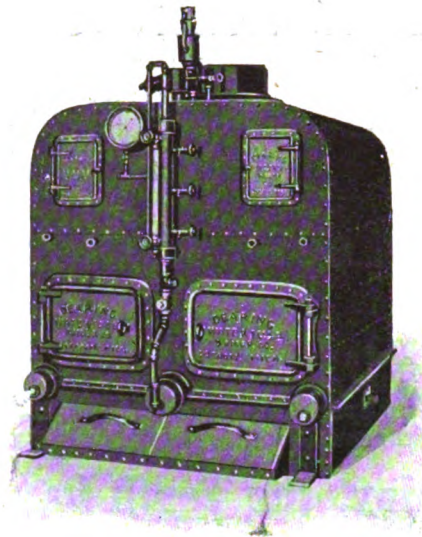
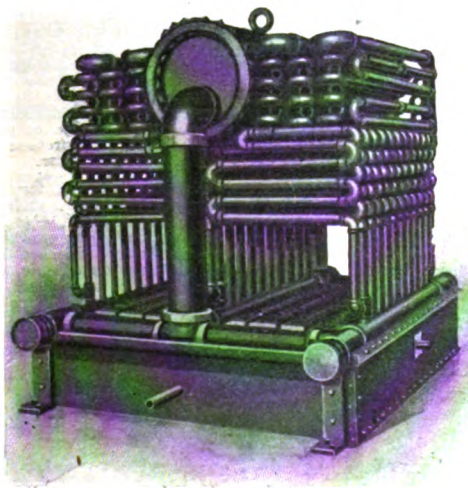
MERCHANT ENGINEERS, AND MANUFACTURERS

Head Office, 246 Summer St., Boston. New York Sales Office, 141 Broadway

Arrested at just the proper point and Confined

to conditions that mean absolutely superior diffusion and combustion of heat elements are essentials provided for by the DEARING WATER TUBE construction.

It's bad business to lose heat! It's a poor plan that retards heat! It's inferior design that induces destruction of primary heating surfaces! It's wretched construction that will not permit "forcing" your steam units when you must.



Study "Dearing"

It requires no forced conception to measure its superiority. It is an ideal high-pressure generating development. No overheated tubes. Perfect circulation. Settling chambers for impurities. Water absorption of heat at minimum fuel cost. Uninterrupted supply of dry steam from a Dome is a wonder-working item of unequalled success. Mechanical supremacy and efficiency absolutely unsurpassed.

Write for Catalogue

**DEARING
WATER TUBE
BOILER Co.**

DETROIT,

MICH.

Commissioners' Sale

of the Shipbuilding Plant and other
property of the William R. Trigg Co.

By N. W. BOWE & SON, Real Estate Auctioneers, Richmond, Va.

By virtue of a decree of the Chancery Court of the City of Richmond, Virginia, entered on the 23rd day of May, 1905, in the suit of S. H. Hawes & Co. vs. William R. Trigg Company et als., the undersigned, who were appointed Special Commissioners for that purpose, will proceed to sell, by public auction, on the premises, Richmond, Virginia, to the highest bidder, on

Monday, the Tenth Day of July, 1905, at 10 o'clock, a. m.

free of all liens and encumbrances whatsoever, except the easements and burdens hereinafter mentioned, all and singular the following estates, lands, properties, rights, privileges, and franchises, to-wit:

All that certain lot or parcel of land, with the buildings and improvements thereon erected, comprising the ship yards, ship building plant, boundaries, shops, railways, manufactories, offices, piers, wharves and docks of the William R. Trigg Co., situate in the city of Richmond, Virginia, more particularly described in two certain deeds of trust made by the William R. Trigg Co. to the Commercial Trust Co., of Philadelphia, trustee, dated June 1, 1901, and to the Richmond Trust & Safe Deposit Co., trustee, dated June 14, 1902, respectively.

The property will be first offered in parcels, as follows:

FIRST—The Richmond Dock, with all rights, easements, privileges and appurtenances thereto belonging, including the franchises of the Richmond Dock Co., together with so much real estate not covered by water as is necessary and appurtenant to its use, as set out and defined in deed dated the first day of June, 1901, from the Chesapeake & Ohio Railway Co. to the William R. Trigg Co., recorded in the clerk's office of the chancery court of the city of Richmond, deed book 171-A, page 245, and subject to the burdens and obligations fixed in said deed.

SECOND—Lot No. 1, with the two (2) office buildings thereon:

Lot No. 2, with the machine shop thereon, together with all the machinery, shafting, motors, cranes and hand and small tools now contained therein;

Lot No. 3, with the pattern shop thereon, together with all machinery, shafting, motors and hand and small tools now contained therein;

Lot No. 4, with the foundry building thereon, together with all machinery, shafting, motors, cranes, cupolas and hand and small tools now contained therein;

Lot No. 5, with the Smith shop thereon, together with all machinery, shafting, motors, cranes and hand and small tools now contained therein;

Lot No. 6, with the bending shed and anglesmith shop thereon, together with all machinery, shafting, motors and hand and small tools now contained therein;

Lot No. 7, with the mold loft thereon, together with all machinery, shafting, motors and hand and small tools now contained therein;

Lot No. 8, with the shipfitters' shed thereon, together with all machinery, shafting, motors and hand and small tools now contained therein;

Lot No. 9, with the carpenter and joiner shop thereon, together with all machinery, shafting, motors and hand and small tools now contained therein;

Lot No. 10, being a vacant piece or parcel of land containing three (3) acres, more or less, lying between the Smith shop and the bending shed;

Lot No. 11, being all of the unoccupied real estate lying east of lot No. 9, and containing fourteen (14) acres, more or less, on which said lot is located a launching basin and ship lock.

The exact location, together with their metes and bounds, of the aforesaid tracts of land will appear from the plats in the possession of the undersigned special commissioners and the auctioneer, access to which is open to the public, and blue prints of which will be furnished to any party applying for the same.

THIRD—The said special commissioners will then proceed to offer

separately each of the aforesaid lots of land, with the buildings thereon as above indicated, *without* the machinery, tools, etc., contained therein, but with the appliances for electric lighting, wiring for power, automatic sprinklers and heating appliances.

FOURTH—The machinery, shafting, motors, cranes and hand and small tools contained in each of the aforesaid buildings in separate parcels, and distinct from the buildings.

FIFTH—All cranes, cableways, shear legs, derricks and other machinery and yard equipment outside of the aforesaid buildings, including a floating machine shop and a floating derrick.

SIXTH—All of the real estate comprising the plant of the William R. Trigg Co., except the dock with its appurtenances as above described, containing about 30 acres, more or less, together with the buildings thereon.

All of the above real estate, including the aforesaid dock, is sold subject to certain easements, rights, licenses, and privileges reserved by the Chesapeake & Ohio Railway Co. in two certain deeds conveying portions of the aforesaid property to said William R. Trigg Co., dated the 1st of June, 1901, and recorded in the clerk's office of the chancery court of the city of Richmond, in deed book 171-A, pages 245 and 258, and subject to certain easements, rights, licenses and privileges set out in two certain deeds between said William R. Trigg Co. and the Southern Railway, each dated the 21st day of November, 1904, recorded in the aforesaid clerk's office in deed book 183-B, pages 315 and 320.

SEVENTH—The said special commissioners will then proceed to offer as a whole the aforesaid land, dock, buildings, machinery, fixtures, equipment and property of every sort, kind and description above referred to, reporting to the court for its acceptance or rejection, the bid or bids aggregating the largest amount of purchase money.

TERMS—The terms of said sale, in the event that the said property is sold as a whole, are as follows: \$50,000 in cash, of which \$10,000 shall be paid to the said special commissioners by the purchaser or purchasers on the date of said sale, and \$40,000 when said sale shall have been confirmed by the court; the balance of the purchase money on equal credits of one, two and three years, the purchaser to execute negotiable notes, bearing interest from the date of the confirmation of said sale, for the deferred payments; with the right in the purchaser to pay the whole amount of purchase money in cash, and to anticipate the due date of any or all of said notes. The title to the property to be retained by the court until the whole of the purchase price is paid, and a deed directed to be executed to the purchaser.

If sold in parcels, then the following are the terms: As to all articles of personal property, or property removable under said decree, all cash; as to the real estate, or any parts thereof, one-fourth of the purchase price in cash, and the balance on equal credits of one, two and three years, the deferred payments being evidenced by purchaser's notes, bearing interest from date of confirmation of sale, with the right in the purchaser to anticipate the due date of any or all of said notes, and title to be retained until the entire purchase money is paid and conveyance ordered by the court.

For further information apply to either of the undersigned Special Commissioners or to the Auctioneer.

BEVERLEY B. MUNFORD
LILBURN T. MYERS

} Special Commissioners.

The bond required of the Special Commissioners by the above named decree has been duly executed.

CHARLES O. SAVILLE,
Clerk of the Chancery Court of the City of
Richmond.

THE NICLAUSSE BOILER.

The largest merchantmen in the world, the S. S. Minnesota and Dakota, of 33,000 tons and 11,000 H. P. each, are equipped with Niclausse Boilers.

641,000 HORSE POWER IN THE NAVIES OF ELEVEN NATIONS.

THE NEW JAPANESE CRUISERS, KATORI AND KASHIMA, OF 16,000 H. P. EACH, AND IN THE UNITED STATES NAVY THE ARMORED CRUISERS PENNSYLVANIA AND COLORADO, 23,000 H. P. EACH, AND THE BATTLESHIPS GEORGIA AND VIRGINIA, 19,000 H. P. EACH, WILL BE FITTED WITH THESE BOILERS.

THE ONLY WATER-TUBE BOILER SUCCESSFULLY USED AND PROVED IN LARGE SHIPS.

Requires no space at sides or rear—cleaned from the front.

Employs no tube-caps—tubes can readily be withdrawn without mutilation.

FORGED STEEL THROUGHOUT.

THE STIRLING COMPANY, General Offices, Trinity Building, NEW YORK.

The Owen Secret Bed



Solves the question of Bed Equipment for Boats, with the greatest economy of space, and perfect convenience and comfort.

A luxurious davenport with no ear-marks of bed combination, for use through the day. For the night—a complete comfortable bed entirely independent, with best bed springs, and regular full size removable mattress, always "made up" with all bed clothing ready for use.

No storing of bedding.
Perfect Ventilation.
Just like a stationary bed.



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**EMBODY IMPORTANT
FEATURES NOT FOUND
IN ANY OTHER MAKE**



**Positively Reliable, Strong
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If your local dealer cannot furnish them, notify us

**THE
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COMPANY**

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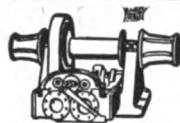
We also manufacture a complete line of Iron & Brass Valves, Injectors, Water Columns, Whistles, Oil and Grease Cups, Cocks, Blow-off & Pop Valves, Mechanical Lubricators, etc.

4 M. R.



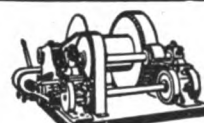
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Suitable for all Boats from 3½ to 200 HP.
Over 100 in successful use.
Also the well known and always reliable Woolters Gas or Gasolene Stationary Engines.



HOISTING ENGINES

Of all kinds and sizes, and for all purposes, especially for ship use.
Docking and Hauling Engines and Wire Rope Windlasses.



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Somewhat the cheapest, and altogether the best. Positively guaranteed.
Automatic Fog Whistle Machines
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THE CHASE MACHINE CO. Engineers and Machinists, CLEVELAND, OHIO.

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Builders of
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Launch of "Mongolia," Pacific Mail S. S. Co., July 25, 1903.
615 feet long, 65 feet beam, 51 feet deep.

Best Facilities for Repair Work

**Pneumatic and Electric Tools;
ample wharfage accomodation.**

100 ton crane.

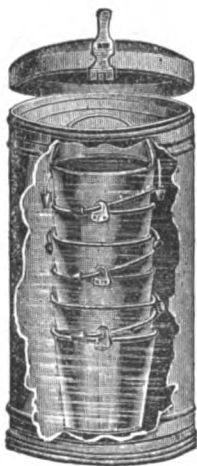
Repairs done under shelter.

SAFETY FIRE BUCKET TANK



An airtight Tank, containing a supply of chemical solution and Six Fire Buckets with self-raising handles.

THIS SOLUTION
REQUIRES NO
ATTENTION—
WILL NOT
EVAPORATE—
FOUL—FREEZE



Always Ready for Use

Now in use by
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Safety Fire Extinguisher Co.

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WHAT BETTER PROOF

could you have to prove the efficiency and commercial value of the Diamond Steam Flue Blower? The following companies have hundreds in constant use—it pays them:

The Pittsburg Steamship Co., Gilchrist Transportation Co., American Ship Building Co., Montreal Transportation Co., Wisconsin & Michigan Central R. R. and many others. Loan you one for thirty days if you doubt its ability.

POWER SPECIALTY CO.

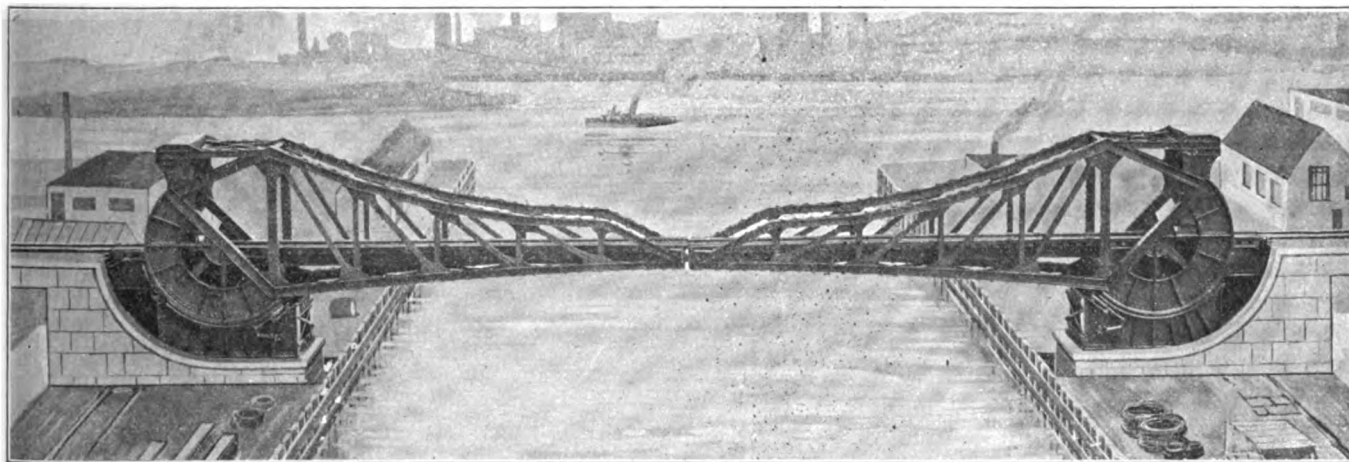
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Windsor, Canada.

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THE JEFFERSON STREET BRIDGE, CLEVELAND, OHIO.

The Cowing Bridge represents the most modern type of Lift Bridge.

Highest Award at
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Plans and estimates
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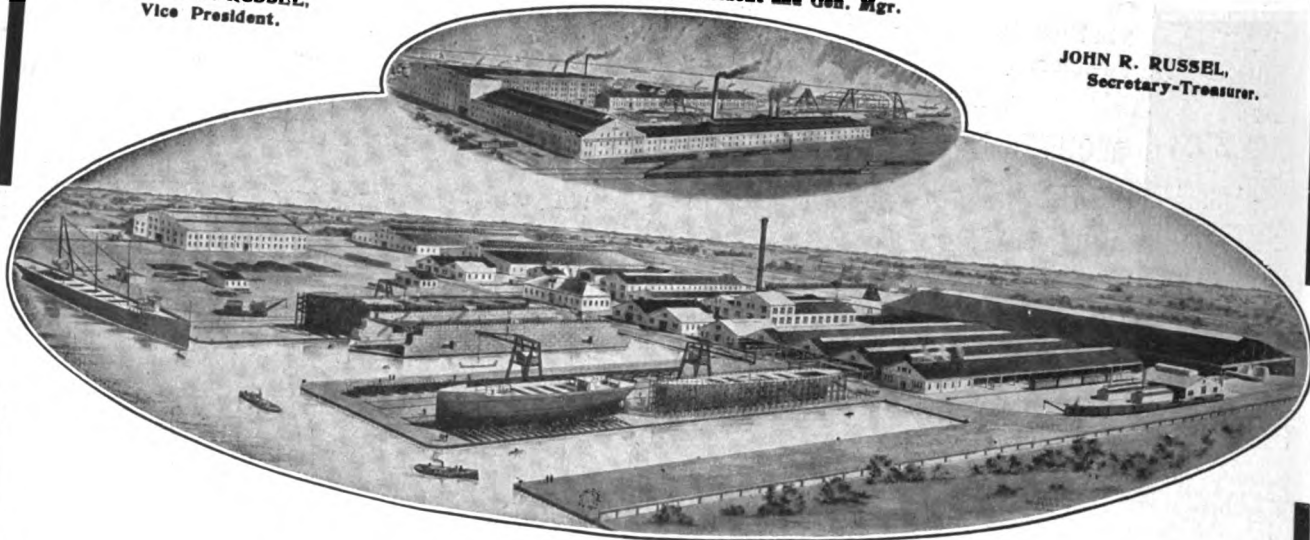
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CLEVELAND, OHIO

THE MARINE REVIEW

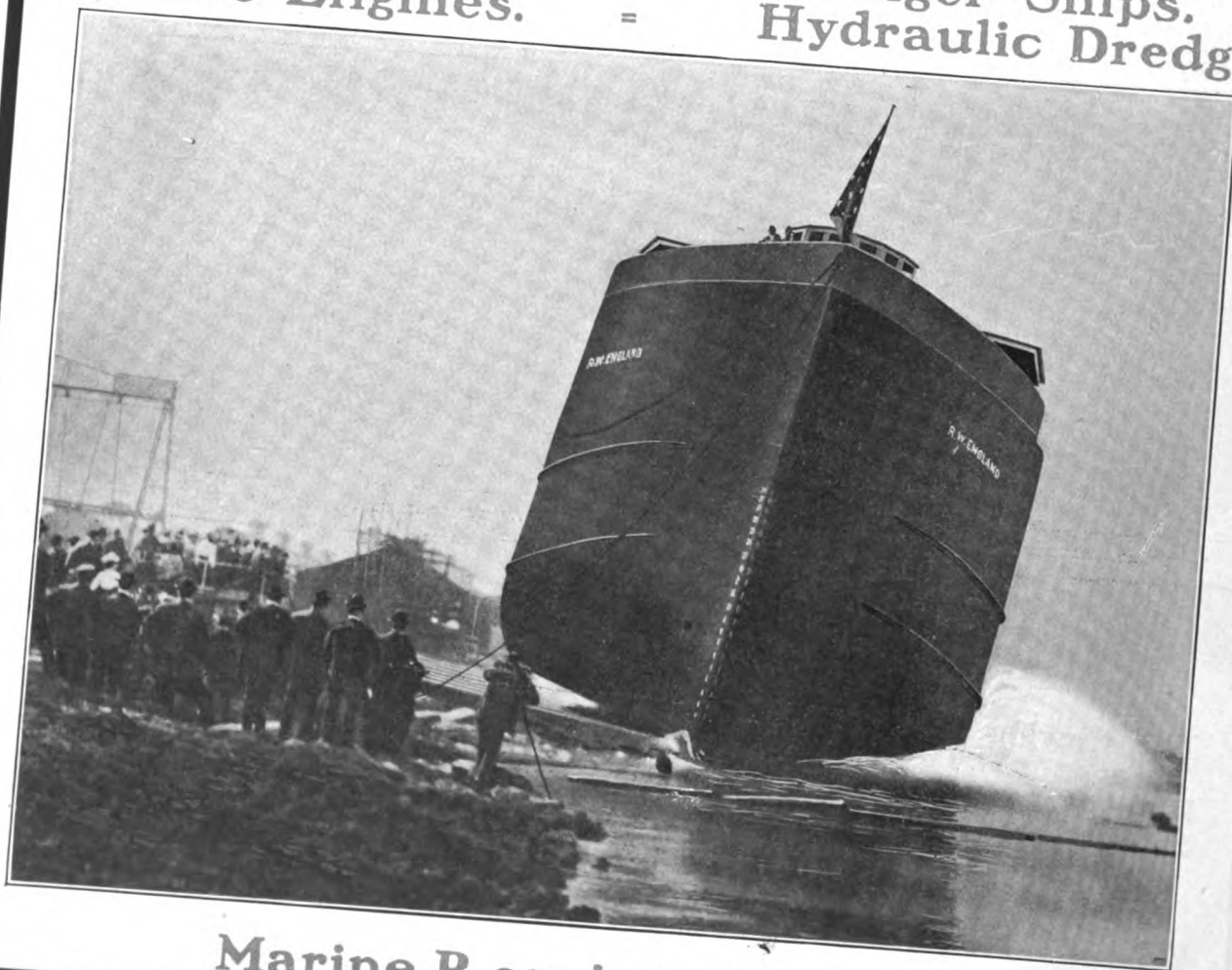
GREAT LAKES ENGINEERING WORKS

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Marine Repairs a Specialty

BELLEVILLE WATER-TUBE BOILERS

NOW IN USE (MARCH, 1905)

On Board Sea-going Vessels, NOT INCLUDING New Installations Building or Erecting.

French Navy	-	-	-	-	-	-	-	-	360,560 H. P.
English Royal Navy	-	-	-	-	-	-	-	-	966,300 "
Russian Imperial Navy	-	-	-	-	-	-	-	-	253,800 "
Japanese Imperial Navy	-	-	-	-	-	-	-	-	122,700 "
Austrian Imperial Navy	-	-	-	-	-	-	-	-	56,700 "
Italian Royal Navy	-	-	-	-	-	-	-	-	32,500 "
Chilian Navy	-	-	-	-	-	-	-	-	26,500 "
Argentine Navy	-	-	-	-	-	-	-	-	13,000 "
The "Messageries Maritimes" Company	-	-	-	-	-	-	-	-	87,600 "
Chemins de fer de l'Ouest: (The French Western Railway Co.)	-	-	-	-	-	-	-	-	Steamships
plying between Dieppe and Newhaven	-	-	-	-	-	-	-	-	18,500 "
Compagnie Generale Transatlantique	-	-	-	-	-	-	-	-	1,500 "
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Cam Lever Pop Safety Valves
and Non-Corrosive
Steam Gauges.

give highest efficiency and durability.
Specify them and get the best.

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Besides ordinary sizes of Plates we have usually kept in stock, we have a good assortment of $\frac{3}{8}$ and $\frac{5}{8}$ " Bessemer Plates 48" to 72" wide, 60 to 144" long.

SEE OUR STOCK LIST.

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BOURNE-FULLER CO.

IRON, STEEL
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COKE

Cleveland, Ohio

Buyers' Directory of the Marine Trade

For a more complete classification than that represented by advertisers in the Marine Review, see the **BLUE BOOK OF AMERICAN SHIPPING**, marine and naval directory of the United States, published by The Marine Review, Cleveland.

See accompanying index of Advertisers for full addresses of concerns in this directory.

AIR COMPRESSORS, AIR HOISTS, ETC.

Great Lakes Engineering Works.....Detroit.
Mietz, Aug. New York.

AIR PORTS, DEAD LIGHTS, ETC.

Marine Mfg. & Supply Co.....New York.

AIR PUMPS AND APPLIANCES.

Fore River Ship & Engine Co. Quincy, Mass.
Great Lakes Engineering Works.....Detroit.

ANCHORS.

Bowers, L. M. & Co.....Binghamton, N. Y.
Seaboard Steel Casting Co.....Chester, Pa.

ANTI-FOULING AND ANTI-CORRO-SIVE COMPOSITION FOR STEEL VESSELS.

Holzappel's American Composition Co.....
.....New York.

ANTI-FRICTION METALS.

Cramp, Wm. & Sons.....Philadelphia.

ARTIFICIAL DRAFT FOR BOILERS.

American Ship Building Co.....Cleveland.
Detroit Ship Building Co.....Detroit.
Great Lakes Engineering Works.....Detroit.
Sturtevant, B. F., Co.....Hyde Park, Mass.

ASH EJECTORS.

Great Lakes Engineering Works.....Detroit.

ATTORNEYS AND PROCTORS IN ADMIRALTY.

Gilchrist, Albert J.....Cleveland.
Goulder, Holding & Masten.....Cleveland.
Hoyt, Dustin & Kelley.....Cleveland.
Kremer, C. E.....Chicago.
MacDonald, Ray G.....Chicago.
Potter & Potter.....Buffalo.
Shaw, Warren, Cady & Oakes.....Detroit.
White, Johnson, McCaslin & Cannon Cleveland

BAROMETERS, MARINE GLASSES, ETC.

Ritchie, E. S. & Sons.....Brookline, Mass.

BEDS

Owens Co., D. T.....Cleveland.

BELT CONVEYORS.

Link Belt Machinery Co.....Chicago.

BLOCKS, SHEAVES, ETC.

Boston & Lockport Block Co.....Boston, Mass.
Cleveland Block Co.....Cleveland.

BLOWERS.

Power Specialty Co.....Detroit.
Sturtevant, B. F. Co.....Hyde Park, Mass.

BOAT BUILDERS.

Drein, Thos. & Son.....Wilmington, Del.
Kahnweiler's Sons, David.....New York.
Lane & McGroot.....Long Island City, N. Y.
Marine Construction & D. D. Co.....
.....Mariner's Harbor, S. I., N. Y.
Truscott Boat Mfg. Co.....St. Joseph, Mich.
Willard, Chas. P. & Co. Winthrop Harbor, Ill.

BOILER CLEANING DEVICE.

Power Specialty Co.....Detroit.

BOILER COMPOUNDS.

Dearborn Drug & Chemical Works....Chicago.

BOILER MANUFACTURERS.

Almy Water Tube Boiler Co. Providence, R. I.
American Ship Building Co.....Cleveland.
Atlantic Works.....East Boston, Mass.
Babcock & Wilcox Co.....New York.
Bertram Engine Works Co., Ltd.....
.....Toronto, Can.
Chicago Ship Building Co.....Chicago.
Cramp, Wm. & Sons.....Philadelphia.
Deering Water Tube Boiler Co.....Detroit.
Delaunay, Belleville & Co.....St. Denis, France.
Detroit Ship Building Co.....Detroit.
East End Boiler Works.....Detroit.
Fletcher, W. A. & Co.....Hoboken, N. J.
Fore River Shipbuilding Co. Quincy, Mass.
Georgian Bay Engineering Works.....
.....Midland, Ont.
Great Lakes Engineering Works.....Detroit.
Kingsford Foundry & Machine Works.....
.....Oswego, N. Y.
Marine Iron Works.....Chicago.

BOILER MANUFACTURERS—Continued.

Maryland Steel Co.....Sparrows Point, Md.
Milwaukee Dry Dock Co.....Milwaukee.
Mosher Water Tube Boiler Co.....New York.
Newport News Ship Building Co.....
.....Newport News, Va.
New York Shipbuilding Co.....Camden, N. J.
Northwestern Steam Boiler & Mfg. Co.....
.....Duluth, Minn.
Roberts Safety Water Tube Boiler Co.....
.....New York.
Stirling, The Co.....New York.
Superior Ship Building Co.....Superior, Wis.
Taylor Water Tube Boiler Co.....Detroit.
Willard, Chas. P. & Co. Winthrop Harbor, Ill.

BOILER RIVETS.

Bourne-Fuller Co.....Cleveland.

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Falls Hollow Staybolt Co. Cuyahoga Falls, O.

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Fore River Ship & Engine Co. Quincy, Mass.
Great Lakes Engineering Works.....Detroit.
Lunkenheimer Co.....Cincinnati.
Macbeth Iron Co.....Cleveland.

BRIDGES, BUILDERS OF.

Cowing, John P.....Cleveland.
Scherzer Rolling Lift Bridge Co.....Chicago.

BUCKETS, ORE AND COAL.

Brown Hoisting & Conveying Machine Co.....
.....Cleveland.
McMyler Mfg. Co.....Cleveland.
Mayo & Bailey.....Chicago.

BULKHEAD DOORS, WATERTIGHT.

"Long Arm" System Co.....Cleveland.

CABIN AND CABINET FINISHING WOODS.

Martin-Barriss Co.....Cleveland.

CANVAS SPECIALTIES.

Baker & Co., H. H.....Buffalo.
Bunker, E. A.....New York.
Upson-Walton Co.....Cleveland.

CAPSTANS.

American Ship Windlass Co. Providence, R. I.
Hyde Windlass Co.....Bath, Me.
Marine Mfg. & Supply Co.....New York.

CARPETS, RUGS AND FURNITURE.

Williams & Rodgers Co.....Cleveland.

CEMENT, IRON FOR REPAIRING LEAKS.

Smooth-On Mfg. Co.....Jersey City, N. J.

CHAINS.

Woodhouse Chain Works.....Trenton, N. J.

CHAIN CONVEYORS, HOISTS.

Brown Hoisting Machinery Co. (Inc.).....
.....Cleveland.
General Electric Co.....Schenectady, N. Y.

CHAIN HOISTS.

Boston & Lockport Block Co.....Boston, Mass.

CHARTS.

Penton Publishing Co.....Cleveland.
Potter, J. D.....London.

CLOCKS (Marine and Ship's Bell) AND CHRONOMETERS.

Ashton Valve Co.....Boston.
Ritchie, E. S. & Sons.....Brookline, Mass.

COAL PRODUCERS AND SHIPPERS.

Hanna, M. A. & Co.....Cleveland.
Ironville Dock & Coal Co.....Toledo, O.
Pickands, Mather & Co.....Cleveland.
Pittsburg Coal Co.....Cleveland.

COAL AND ORE HANDLING MACHINERY.

Brown Hoisting Machinery Co. (Inc.).....
.....Cleveland.
Link Belt Machinery Co.....Chicago.
McMyler Mfg. Co.....Cleveland.

COMPASSES.

Ritchie, E. S. & Sons.....Brookline, Mass.

CONDENSERS.

Great Lakes Engineering Works.....Detroit.
Thropp & Sons Co., John E. Trenton, N. J.

CONTRACTORS FOR PUBLIC WORKS.

Breyman & Bros., G. H.....Toledo.
Buffalo Dredging Co.....Buffalo.
Chicago & Gt. Lakes Dredge & Dock Co.....
.....Chicago.
Dunbar & Sullivan Dredging Co.....Buffalo.
Fitz-Simons & Connell Co.....Chicago.
Hickler Bros.....Sault Ste. Marie, Mich.
Lake Superior Contracting & Dredging Co.....
.....Duluth, Minn.
Smith Co., L. P. & J. A.....Cleveland.
Starke Dredge & Dock Co., C. H. Milwaukee.
Sullivan, M.....Detroit.

CORDAGE.

Baker & Co., H. H.....Buffalo.
Upson-Walton Co.....Cleveland.

CORK JACKETS AND RINGS.

Armstrong Cork Co.....Pittsburg, Pa.
Kahnweiler's Sons, D.....New York.

CRANES, TRAVELING.

Brown Hoisting Machinery Co.....Cleveland.
McMyler Mfg. Co.....Cleveland.

DIVING APPARATUS.

Morse, A. J. & Son.....Boston.
Schrader's Son, A.....New York.

DREDGING CONTRACTORS.

Breyman & Bros., G. H.....Toledo.
Buffalo Dredging Co.....Buffalo.
Chicago & Gt. Lakes Dredge & Dock Co.....
.....Chicago.
Dunbar & Sullivan Dredging Co.....Buffalo.
Fitz-Simons & Connell Co.....Chicago.
Hickler Bros.....Sault Ste. Marie, Mich.
Lake Superior Contracting & Dredging Co.....
.....Duluth, Minn.
Smith Co., L. P. & J. A.....Cleveland.
Starke Dredge & Dock Co., C. H. Milwaukee.
Sullivan, M.....Detroit.

DRYING APPARATUS.

Sturtevant, B. F. Co.....Hyde Park, Mass.

DRY DOCKS.

American Ship Building Co.....Cleveland.
Atlantic Works.....East Boston, Mass.
Buffalo Dry Dock Co.....Buffalo.
Chicago Ship Building Co.....Chicago.
Craig Ship Building Co.....Toledo, O.
Cramp, Wm. & Sons.....Philadelphia.
Detroit Ship Building Co.....Detroit.
Great Lakes Engineering Works.....Detroit.
Lockwood Mfg. Co.....East Boston, Mass.
Milwaukee Dry Dock Co.....Milwaukee.
Newport News Ship Building Co.....
.....Newport News, Va.
Shipowners Dry Dock Co.....Chicago.
Superior Ship Building Co.....Superior, Wis.

ELECTRIC HOISTS AND CRANES.

General Electric Co.....Schenectady, N. Y.

ELECTRIC LIGHT AND POWER PLANTS.

General Electric Co.....Schenectady, N. Y.
Mietz, Aug. New York.
Sturtevant, B. F. & Co.....Hyde Park, Mass.
Thropp & Sons, John E. Trenton, N. J.

WANTED and FOR SALE Department.**PROPOSALS.**

U. S. Engineer Office, Buffalo, N. Y., May 6, 1905. Sealed proposals for channel excavation at Ogdensburg Harbor, N. Y., will be received here until 11 A. M., June 6, 1905, and then opened. Information furnished on application. H. M. Adams, Lieut. Col. Engrs. June 1

PROPOSALS FOR REPAIR OF JETTIES.—U. S. Engineer Office, 262 Huron Street, Cleveland, Ohio, May 8, 1905. Sealed proposals for Stone Reinforcement and Repair of Jetties at the harbors of Port Clinton, and Vermilion, Ohio, will be received at this office until 2 P. M., June 8, 1905, and then publicly opened. Specifications, blank forms, and all available information will be furnished on application to this office. DAN C. KINGMAN, Lieut. Col. Corps of Engineers, U. S. A. June 1

PROPOSALS FOR DREDGING.—U. S. Engineer Office, 262 Huron Street, Cleveland, Ohio, May 5, 1905. Sealed proposals for dredging in Sanousky Harbor, Ohio, will be received at this office until 2 P. M., Standard Time, June 5, 1905, and then publicly opened. Specifications, blank forms, and all available information will be furnished on application to this office. DAN C. KINGMAN, Lieut. Col. Corps of Engineers, U. S. A. June 1

U. S. Engineer Office, Duluth, Minn., May 4, 1905. Sealed proposals for pier work at Port Wing, Wis., will be received here until noon, June 5, 1905, and then publicly opened. Information on application. Chas. L. Potter, Major, Engrs. June 1

U. S. Engineer Office, Detroit, Mich., May 11, 1905. Sealed proposals for building concrete superstructure on main pier at Harbor Beach harbor of refuge, Mich., will be received here until 12:00 M., June 10, 1905, and then publicly opened. Information furnished on application. Lansing H. Beach, Major, Engrs. June 8

U. S. Engineer Office, Jones Building, Detroit, Mich., May 22, 1905. Sealed proposals for hire of one dredging plant and one steam derrick boat for use in St. Mary's River, Michigan, will be received here until 2 P. M., June 22, 1905, and then publicly opened. Information furnished on application. CHAS. E. L. B. DAVIS, Lieut.-Col., Engineers. June 15

PROPOSALS FOR CONSTRUCTING BREAKWATER.—U. S. Engineer Office, 262 Huron Street, Cleveland, Ohio, May 20, 1905. Sealed proposals for constructing the Shoreward End of the West Breakwater at Ashtabula Harbor, Ohio, will be received at this office until 2 P. M., June 19, 1905, and then publicly opened. Specifications, blank forms and all available information will be furnished on application to this office. DAN C. KINGMAN, Lieut.-Col. Corps of Engineers, U. S. A. June 15

PROPOSALS.

U. S. Engineer Office, Jones Building, Detroit, Mich., May 20, 1905. Sealed proposals for dredging in St. Mary's River, at Bayfield Shoal and Entrance Angle to Middle Neebish, will be received here until 2 P. M., June 20, 1905, and then publicly opened. Information furnished on application. CHAS. E. L. B. DAVIS, Lieut.-Col. Engineers. June 15

U. S. Engineer Office, Duluth, Minn., May 27, 1905. Sealed proposals for pile dike and riprap at Grand Marais, Mich., will be received here until noon, June 26, 1905, and then publicly opened. Information on application. CHAS. L. POTTER, Major, Engrs. June 22

U. S. Engineer Office, Duluth, Minn., May 27, 1905. Sealed proposals for dredging about 117,000 yards in Portage Lake Ship Canals, Keweenaw Point, Michigan, will be received here until noon, June 27, 1905, and then publicly opened. Information on application. CHAS. L. POTTER, Major, Engrs. June 22

FOR SALE.**Patent on Valuable Nautical Invention.**

A device in the form of an air buoy for definitely locating sunken vessels. Should the vessel sink upon which this buoy is placed, the buoy floats, and a line, made fast in a separate compartment, unreels until the vessel strikes bottom, thereby locating the exact position of the sunken vessel. This buoy is also adapted for use as a mooring buoy for yachts of all sizes, and for all floating property. It can be manufactured and sold for much less than any other buoy in use. Will sell the patent for cash or exchange for vessel or other property. Address, Capt. J. Fred Tribble, 59 Broadway, Norwich, Conn. t.f.

Steamer A. A. Turner.

For Sale at a Bargain. Patrick McTigue, No. 2 Taylor St., Cleveland, O.

For Sale.

Ten shares of stock of Manitowoc Dry Dock Company, Manitowoc, Wis. Address Box 80, Marine Review. t.f.

FOR SALE.**The Steamer Gordon Campbell.**

Burned on spar-deck—easy to cut down to lumber barge, to carry million feet. Machinery and boilers untouched. Hull untouched and in good condition. Boat in dry dock and thoroughly overhauled last summer. Can be seen in Chicago. Want best offer. Address Room 613, 59 Dearborn St., Chicago. t.f.

Tug Jim Pullar and Scow.

Tug—built in 1894; 61 ft. long; 15 ft. beam. Water tube boiler. Compound condensing engine. Strong and seaworthy.

Scow—five years old. Excellent construction; 132 ft. long; 29½ ft. wide at center, 26 ft. wide at ends. Platform style, with stake pockets.

Tug and Scow recently overhauled and are in good condition. May be seen at Washburn, Wis., dock.

Address, Fowler-Jacobs Co., Fisher Building, Chicago. t.f.

For Sale.

FOR SALE.—Electric dynamos, direct connected to engines, also search-lights for marine work; good condition; cheap. JORDAN BROS., 74 Beekman St., New York. April 27

WANTED.**Salesmen Wanted.**

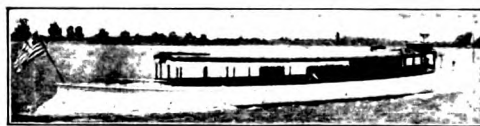
Wanted.—Salesmen or agents to sell a patented specialty of great merit for boilers, which is already being used by the largest concerns. Address Power Specialty Co., 513 Washington Arcade, Detroit, Mich. t.f.

Boiler Wanted.

WANTED—Second-hand marine boiler large enough to supply a 20 x 22 cylinder and withstand 125 lbs. working pressure. Great Lakes Dredge & Dock Co., 1317-1322 Chamber of Commerce Bldg., Chicago.

**Steam Yacht Catherine.**

FOR SALE—Length 78 ft., beam 18 ft., triple expansion engines, water-tube boiler, allowed 200 lbs.; electric light, search light, mahogany deck-house 9 x 16, power launch, complete outfit, all in first-class condition. One of the best family cruising yachts on the Lakes. Inquire Wickes Bros., Saginaw, Mich. t.f.

**For Sale.**

This up-to-date Gasoline Yacht 65x9½, mahogany finished throughout; large cabin, plate glass windows, mahogany blinds; fine carpets and upholstery; excellent electric light plant—dynamo, storage batteries and search light. Entire boat can be easily converted into cabin if desired.

Rapid fire yacht cannon; anchor, life preservers, flags, etc., complete. Very fast 4 cylinder, 4 cycle King engine of 50 h. p. Cost nearly \$8,000, will sell at great bargain.

O. J. MULFORD, Stevens Bldg., Detroit.

Marine Boiler.

For Sale.—One 50 H. P. Scotch Marine Boiler, 10 ft. long, 78 in. diameter, 160 lbs. steam pressure. Manufactured by Ritter & Co., Buffalo, N. Y. In first-class shape. For particulars, write The Detroit Stove Works, Detroit, Mich. t.f.

Buyers' Directory of the Marine Trade.—Continued.

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 Atlantic Works. East Boston, Mass.
 Bertram Engine Works Co., Ltd. Toronto, Can.
 Chicago Ship Building Co. Chicago.
 Chase Machine Co. Cleveland.
 Cramp, Wm. & Sons. Philadelphia.
 Craig Ship Building Co. Toledo, O.
 Duke Engine Co. Grand Haven, Mich.
 Detroit Ship Building Co. Detroit.
 Fletcher, W. & A. Co. Hoboken, N. J.
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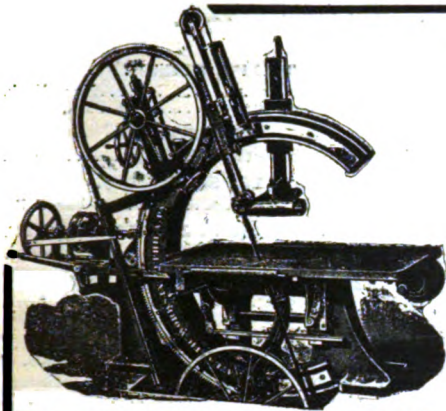
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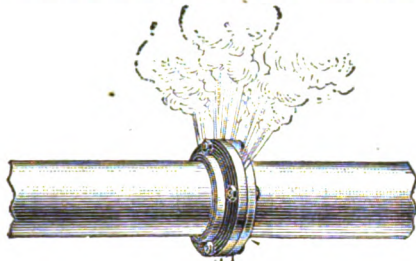
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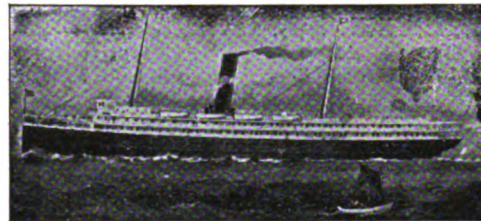
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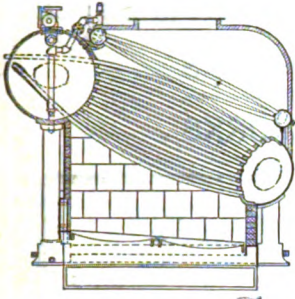
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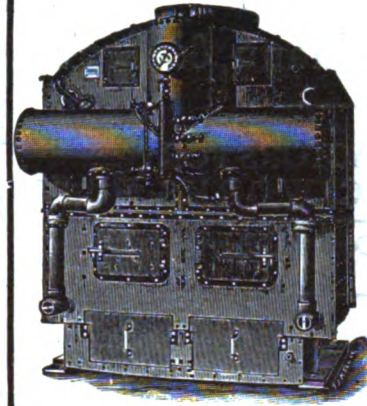


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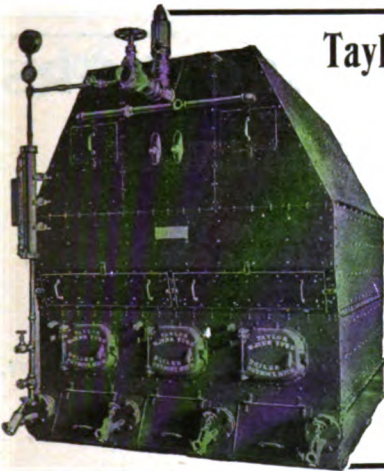
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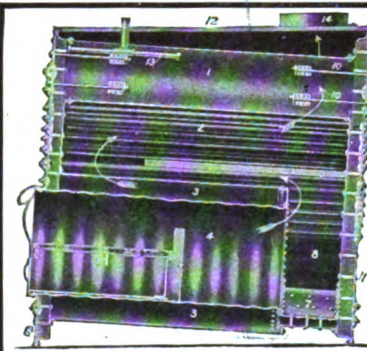


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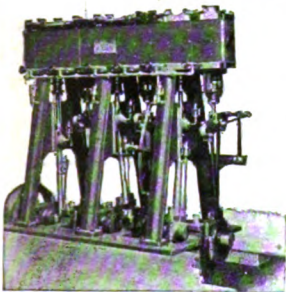
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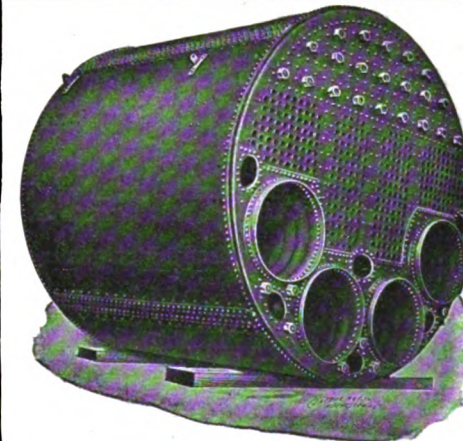
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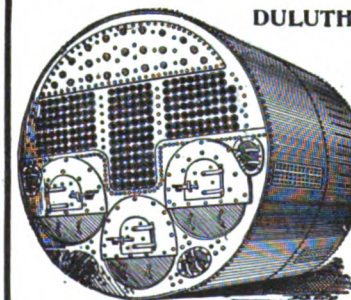
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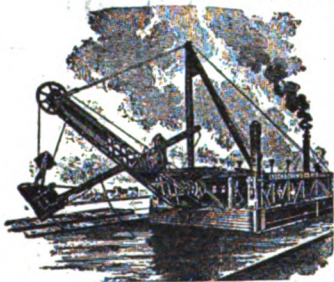
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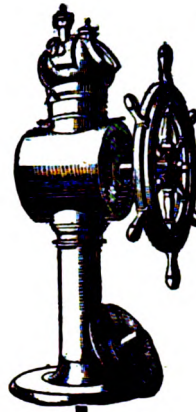
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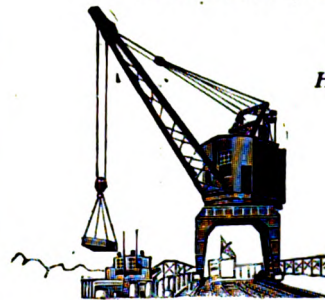
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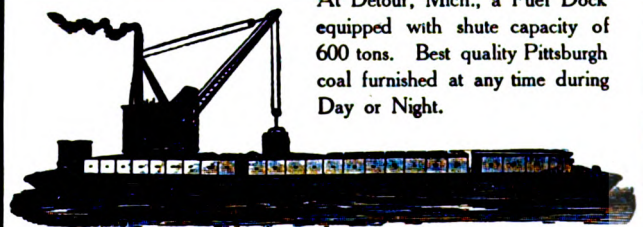
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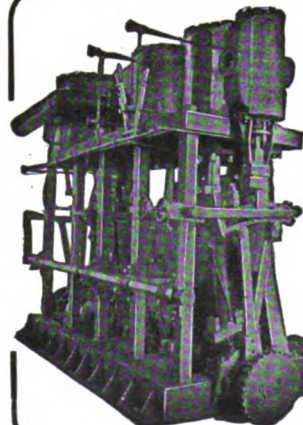
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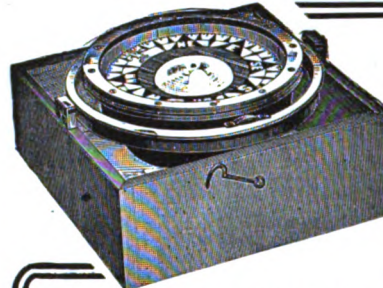
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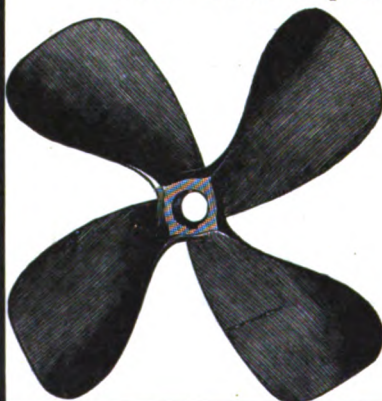
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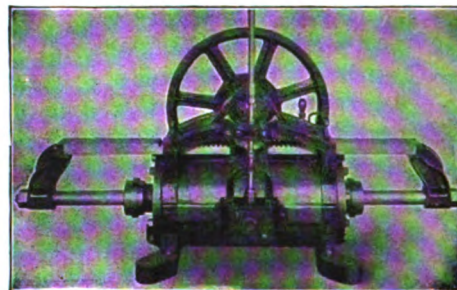
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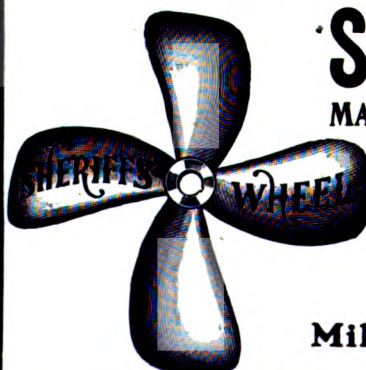
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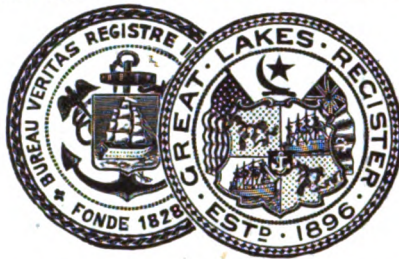
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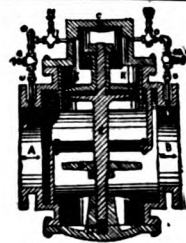
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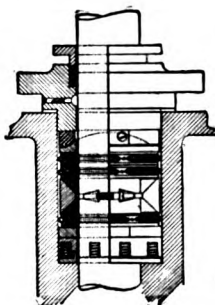
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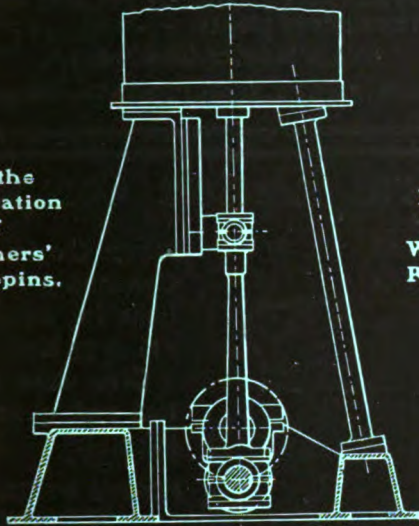
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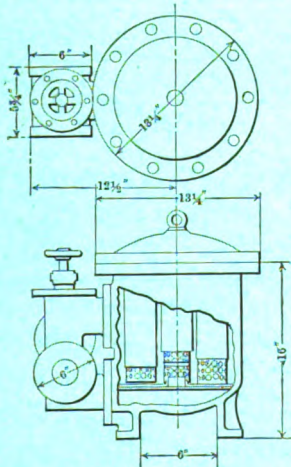


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No. 20, Chicago and Cleveland Exp.	*7:20 a.m.	
No. 28, New York and Boston Exp.	*7:40 a.m.	*8:00 a.m.
No. 40, Toledo and Buffalo Accom. ..	†10:00 a.m.	†10:30 a.m.
No. 32, Fast Mail	*11:25 a.m.	*11:30 a.m.
No. 48, Accommodation via Sandusky ..	†1:40 p.m.	
No. 42, Boston-New York Express ..		*11:45 a.m.
No. 44, Cleveland and New York Spl.		*3:00 p.m.
No. 46, Southwestern Express		*3:10 p.m.
No. 116, Ashtabula Accommodation.		†4:30 p.m.
No. 6, Limited Fast Mail	*5:40 p.m.	*5:45 p.m.
No. 26, 20th Century Limited	*7:40 p.m.	*7:43 p.m.
No. 10, Chicago, N.Y. & Boston Spl.	*7:30 p.m.	*7:50 p.m.
No. 16, New England Express	*10:30 p.m.	*10:35 p.m.
No. 2, Day Express	†9:10 p.m.	†9:25 p.m.
No. 126, Norwalk Accommodation ..	†7:55 a.m.	
Westward	Arrive from East	Depart West
No. 7, Exposition Limited	*12:50 a.m.	
No. 11, Southwestern Limited	*2:55 a.m.	
No. 9, Day Express		†6:00 a.m.
No. 15, Boston and Chicago Special.	*3:10 a.m.	*3:15 a.m.
No. 19, Lake Shore Limited	*7:15 a.m.	*7:25 a.m.
No. 23, Western Express	*10:30 a.m.	*10:35 a.m.
No. 29, Southwestern Special.	†11:10 a.m.	
No. 33, Southwestern Express	*12:25 p.m.	
No. 133, Cleveland and Detroit Exp.		*12:45 p.m.
No. 47, Accommodation	†11:00 a.m.	†3:00 p.m.
No. 141, Sandusky Accommodation.		†3:10 p.m.
No. 43, Fast Mail	*4:35 p.m.	*4:40 p.m.
No. 127, Norwalk Accommodation ..		†5:10 p.m.
No. 37, Pacific Express	*6:50 p.m.	*7:20 p.m.
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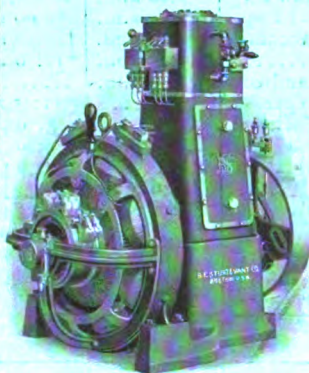
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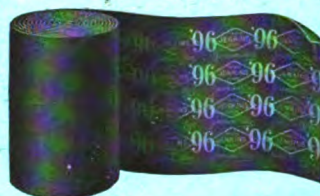
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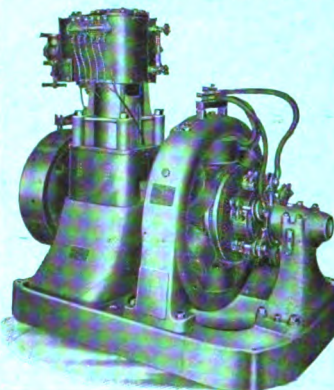
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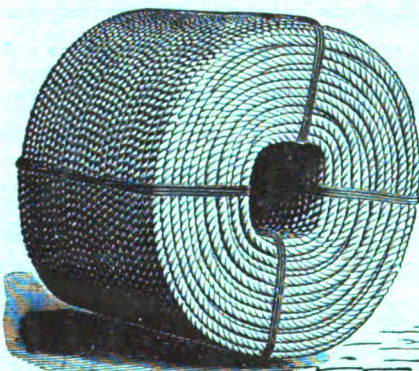
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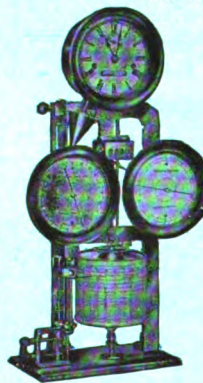


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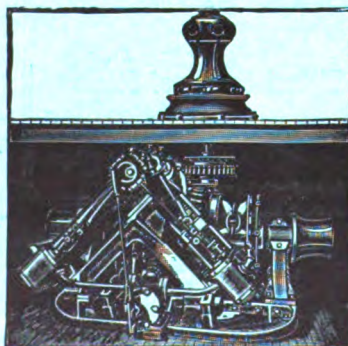


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